

[M, 11/28/94]

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Bob: After you return next draft, could you make a list of places (not dates) some of the material has appeared in — Parade, NYT, Washington Post, etc.? It's for intro.

Timothy
C.

THE DEMON-HAUNTED WORLD:
SCIENCE AS A CANDLE IN THE DARK

by Carl Sagan

[Error bar used as logo.]

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[M, 11/28/94]

We wait for light, but behold darkness.

-- Isaiah 59:9

It is better to light one candle than to curse the darkness.

-- adage

[M, 11/28/94]

THE DEMON-HAUNTED WORLD

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Preface

MY TEACHERS

It was a blustery fall day in 1939. In the streets outside the apartment building fallen leaves were swirling in little whirlwinds, each with a life of its own. It was good to be inside and warm and safe, with my mother preparing dinner in the next room. In our apartment there were no older kids who picked on you for no reason. Just the week before, I had been in a fight -- I can't remember, after all these years, who it was with; maybe it was Snoony Agata from the third floor -- and, after a wild swing, I found I had put my fist through the plate glass window ^{of} in Schechter's drug store.

Mr. Schechter was solicitous: "It's all right, I'm insured," he said as he put some unbelievably painful antiseptic on my wrist. My mother took me to the doctor whose office was on the ground floor of our building. With a pair of tweezers, he pulled out a fragment of glass. Using needle and thread, he sewed two stitches.

"Two stitches!" my father ^{had} repeated later that night. He knew about stitches, because he was a cutter in the garment industry; his job was to use a very scary power saw to cut out patterns -- backs, say, or sleeves for ladies' coats and suits -- from an enormous stack of cloth. Then the patterns were conveyed to endless rows of women ^{sitting} at sewing machines. He was pleased I had gotten angry enough to overcome a natural timidity. ~~~~~~~~~

4 Sometimes it was good to fight back. I hadn't planned to do anything violent. It just happened. One moment Snoony was pushing me and the next moment my fist was through Mr. Schechter's window. I had injured my wrist, generated an unexpected medical expense, and broken a plate glass window, and no one was mad at me. Snoony was more friendly than ever.

I puzzled over what the lesson was. But it was much more pleasant to work it out up here in the warmth of the apartment, gazing out through the living room window into the gray of Lower New York Bay, than to risk some new misadventure on the streets below.

As she often did, my mother had changed her clothes and made up her face in anticipation of my father's arrival. The Sun was almost setting and together we looked out across the choppy waters.

"There are people fighting out there, killing each other," she said, waving vaguely across the Atlantic. I peered intently.

"I know," I replied. "I can see them."

"No, you can't," she answered, almost severely, before returning to the kitchen. "They're too far away."

How could she know whether I could see them or not? I wondered. Squinting, I had thought I'd made out a thin strip of land at the horizon on which tiny figures were pushing and shoving and dueling with swords as they did in Classic Comics. Maybe she was right. Maybe it had just been my imagination, a

little like the nocturnal monsters that still, on occasion, awakened me from a deep sleep, my pajamas drenched in sweat, my heart pounding.

How could you tell when somebody was only imagining? I gazed out across the gray waters until night fell and I was called to wash my hands for dinner.

* * *

Suddenly,

childish

On a Sunday in ^{that} ~~the~~ same year, my father had patiently explained to me about zero as a placeholder in arithmetic, about how there's no biggest number ("you can always add one," he ^{pointed out} ~~reminded me~~), and about the wicked-sounding names of big numbers. ~~I was seized by a compulsion to~~ Gradually I conceived the project ^{of} writing out in sequence all the integers from 1 to 1,000. We had no pads of paper, but my father offered up the ^{stack of} ~~pieces of~~ gray cardboard ^s he had been saving from when his shirts were sent to the laundry. I ^{my project} ~~started out~~ eagerly, but was surprised at how slowly the project went. When I had gone no further than the low hundreds, my mother announced that it was time for me to take my bath. I was disconsolate. I had to get to a thousand. A mediator his whole life, my father intervened: If I would cheerfully submit to the bath, he would continue the sequence. I was overjoyed. By the time I emerged, he was approaching 900, and I was able to reach 1,000 only a little past my ordinary bedtime. The magnitude of large numbers

has never ceased to impress me.

Also in 1939 my parents took me to the New York World's Fair. There, I was offered a vision of a perfect future made possible by science and high technology. A time capsule was buried, packed with artefacts of our time for the benefit of people in the far future -- who, astonishingly, might not know much about us in 1939. The "World of Tomorrow" would be sleek, clean, streamlined and, as far as I could tell, without a trace of poor people.

"See sound," one exhibit bewilderingly commanded. And sure enough, when the tuning fork was struck by the little hammer, a beautiful sine wave marched across the oscilloscope screen.

"Hear light," another poster exhorted. And sure enough, when a flashlight shone on the photocell, I could hear something like the static on our Motorola radio set when the dial was between stations. Plainly the world held wonders of a kind I had never guessed. How could a tone become a picture and light become a noise?

My parents were not scientists. ~~In a way~~ ^T they knew almost nothing about science. But in introducing me simultaneously to skepticism and to wonder, they taught me the two uneasily cohabiting modes of thought that are central to the scientific method. ^{They were only one step out of poverty. But} ~~And~~ when I announced that I wanted to be an astronomer, I received unqualified support -- even if they (as I) had only the most rudimentary idea of what an astronomer does. They never

suggested that, all things considered, it might be better to be a doctor or a lawyer.

I wish I could tell you about inspirational teachers in science from my elementary or junior high or high school days. But as I think back on it, there were none. There was rote memorization about the Periodic Table of the Elements, levers and inclined planes, green plant photosynthesis, and the difference between anthracite and bituminous coal. But there was no soaring sense of wonder, no hint of an evolutionary perspective, and nothing about mistaken ideas that everybody had once believed. In high school laboratory courses, there was an answer we were supposed to get. We were marked off if we didn't get it. There was no encouragement to pursue our own interests or hunches or conceptual mistakes. In the backs of textbooks there was material you could tell was interesting. The school year would always end before we got to it. You could find wonderful books on astronomy, say, in the libraries, but not in the classroom. Long division was taught as a set of rules from a cookbook, with no explanation of how this particular sequence of short divisions, multiplications, and subtractions got you the right answer. In high school, extracting square roots was offered as ^{if it were} a method once handed down from Mt. Sinai, ~~and~~ ^I It was our job merely to remember what we had been commanded. Get the right answer, and never mind that you don't understand what you're doing. I had a very capable ^{second-year} algebra teacher from whom I learned much

mathematics; but he was also a bully who enjoyed reducing young women to tears. My interest in science was maintained through all those school years by ^{reading} books and magazines on science ^{fact} and ~~science~~ fiction.

College was the fulfillment of my dreams: I found teachers who not only understood science, but who were actually able to explain it. I was lucky enough to attend one of the great institutions of learning of the time, the University of Chicago. I was a physics student in a department orbiting around Enrico Fermi; I ^{discovered} ~~learned~~ what true mathematical elegance ^{is} ~~was~~ from Subrahmanyan Chandrasekhar^h; I was given the chance to talk chemistry with Harold Urey; over summers I was apprenticed in biology to H. J. Muller at Indiana University; and I learned planetary ^{astronomy} ~~science~~ from its only full-time practitioner at the time, G. P. Kuiper. It was from Kuiper that I got a feeling for what is called a back-of-the-envelope calculation: A possible explanation to a problem occurs to you, you pull out an old envelope, appeal to your knowledge of fundamental physics, scribble a few approximate equations on the envelope, substitute in likely numerical values, and see if your answer comes anywhere near explaining your problem. If not, you look for a different explanation. It cut through nonsense like a knife through butter.

At the University of Chicago I also was lucky enough to go through a general education program devised by Robert M.

Hutchins, where science was presented as an integral part of the gorgeous tapestry of human knowledge. It was considered unthinkable for an aspiring physicist not to know Aristotle, Bach, Shakespeare, ^{Gibbon,} Malinowski, and Freud. In an introductory science class, Ptolemy's view that the Sun revolved around the Earth was presented so compellingly that some students found themselves re-evaluating their commitment to Copernicus. The status of the teachers in the Hutchins curriculum had almost nothing to do with their research; perversely -- unlike the American university standard of today -- teachers were valued for their teaching, *their ability to inform and inspire the next generation.*

In this heady atmosphere, I was able to fill in at least some of the gaps in my education. Much that had been deeply mysterious, and not just in science, became clearer. I also witnessed at first hand the joy felt by those whose privilege it is to uncover a little about how the ^{Universe} ~~world~~ works.

I've always been grateful to my mentors of the 1950s, and tried to make sure that each of them knew my appreciation. But as I look back, it seems clear to me that I learned the most essential things not from my school teachers, nor even from my university professors, but from my parents, who knew nothing at all about science, in ^{that} ~~the~~ single far-off year of 1939.

(DAVE)

[M, 11/28/94]

Chapter 1

SCIENCE AND HOPE

Two men came to a hole in the sky. One asked the other to lift him up. . . But so beautiful was it in heaven that the man who looked in over the edge forgot everything, forgot his companion whom he had promised to help up and simply ran off into all the splendor of heaven.

-- from an Iglulik Eskimo prose poem, early twentieth century, told by Inugpasugjuk to Knud Rasmussen, the Greenlandic arctic explorer

I was a child in a time of hope. I wanted to be a scientist from my earliest school days. The crystallizing moment came when I first caught on that the stars are mighty suns, when it first dawned on me how staggeringly far away they must be to appear as mere points of light in the sky. I'm not sure I even knew the word science then, but I wanted somehow to immerse myself in all that grandeur. I was gripped by the splendor of the Universe, transfixed by the prospect of understanding how things really work, of helping to uncover deep mysteries, of exploring new worlds -- maybe even literally. It has been my good fortune to have had that dream in part fulfilled. For me, the romance of science remains as appealing and new as it was on that day, more than half a century ago, when I was shown the wonders of the 1939 World's Fair.

Popularizing science -- trying to make its methods and findings accessible to non-scientists -- then follows naturally and immediately. Not explaining science seems to me perverse.

Science is more than a body of knowledge; it is a way of thinking.

["Science and Hope" (M, 11/28/94)]

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When you're in love, you want to tell the world.

But there's another reason: I have a foreboding of an America in my children's or grandchildren's time -- when we're a service and information economy; when nearly all the key manufacturing industries have slipped away to other countries; when awesome technological powers are in the hands of a very few, and no one representing the public interest can even grasp the issues; when the people have lost the ability to set their own agendas or knowledgeably question those in authority; when, clutching our crystals and religiously consulting our horoscopes, our critical faculties in decline, unable to distinguish between what feels good and what's true, we slide, almost without noticing, back into superstition and darkness.

We've arranged a global civilization in which most crucial elements -- transportation, communications, and all other industries; agriculture, medicine, education, entertainment, protecting the environment; and even the key democratic institution of voting -- profoundly depend on science and technology. We have also arranged things so that almost no one understands science and technology. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces.

For much of our history, we were so fearful of the outside world, with its unpredictable dangers, that we gladly embraced anything that promised to soften ^{or explain} the terror. Science is an

9 A Candle in the Dark is the title of a courageous book by Thomas Ady, published in London in 1656, attacking the witchhunts ^{then in progress} as a delusion scam "to delude the people." Any illness or storm, anything out of the ordinary, was attributed to witchcraft. Witches must exist, Ady portrayed the "witch-
["Science and Hope" (M, 11/28/94)] mongers" as arguing -- "else how should these things be, or come to pass?"

attempt, largely successful, ^{to understand the world} to get a grip on things, to get hold of ourselves, to steer a safe course. Medicine and meteorology now explain what only a few centuries ago was considered ^{sufficient} cause to burn women. I worry that as the Millennium edges nearer, pseudoscience and superstition will seem year by year more tempting, the siren song of unreason more sonorous and attractive. Where have we heard it before? Every time there's an economic downturn, whenever our ethnic or national prejudices are aroused, in times of scarcity, in challenges to national self-esteem or nerve, when we agonize about our diminished cosmic place and purpose, or when fanaticism is bubbling ^{up} all around us -- then, a habit ^s of thought familiar from ^{ages past} ~~the childhood of our species~~ reaches for the controls. ~~In a crisis we appeal to the old solutions.~~

The candle flame gutters. Its little pool of light trembles. Darkness gathers. The demons begin to stir.

* * *

In every area of human endeavor science has made at least one important contribution. Of course, there's much about which even experts are ignorant; this will always be true. Science is far from a perfect instrument of knowledge. It's just the best one we have. In this respect, as in many others, it's like democracy. Science by itself cannot advocate courses of human action, but it can certainly illuminate the possible consequences of alternative courses of action.


Science is much more than a body of knowledge. It is a way of thinking, at once imaginative and disciplined. This is central to its success. Science invites us to let the facts in, even when they don't conform to our preconceptions. It counsels us to carry alternative hypotheses in our heads and see which best fit the facts. It urges on us a delicate balance between no-holds-barred openness to new ideas, however heretical, and the most rigorous skeptical scrutiny of everything -- new ideas and established wisdom. We need wide appreciation of this kind of thinking. It works. It's an essential tool for a democracy in an age of change. It's critical not just in training more scientists (which, in a way, is easy) but also in deepening public understanding of science (which is more difficult).

One of the reasons for its success is that science has built-in, error-correcting machinery at its very heart. It takes account of human fallibility. Some may consider this an overbroad characterization, but to me every time we exercise self-criticism, every time we test our ideas against the outside world, then we are doing science. When we are self-indulgent and uncritical, when we confuse hopes and facts, we pass into pseudoscience and superstition. At the other extreme, when we are hypercritical and hold that all ideas are self-serving and mere expressions of our prejudices, that anything approaching objective knowledge is unattainable, then we pass into a kind of antiscientific nihilism.

Every time a scientific paper presents a bit of data, it's accompanied by an error bar -- a quiet but insistent reminder that no knowledge is complete or perfect. It's a calibration of how much we trust what we think we know. If the error bars are small, the accuracy of our knowledge is high; if the error bars are large, then so is the uncertainty in our knowledge. Except in pure mathematics (and maybe not even there), nothing is known for certain. Moreover, scientists are usually careful to characterize the veridical status of their attempts to understand the world -- ranging from conjectures and hypotheses, which are highly tentative, all the way up to laws of Nature which are repeatedly and systematically confirmed through many interrogations of how the world works. But even laws of Nature are not absolutely certain. There may be new circumstances never before examined -- inside black holes, say, or within the electron, or close to the speed of light -- where even our vaunted laws of Nature break down and, however valid they may be in ordinary circumstances, need correction.

Humans may crave absolute certainty; they may aspire to it; they may pretend, as certain religions do, to have attained it. But the history of science -- by far the most successful claim to knowledge accessible to humans -- teaches that the most we can hope for is successive improvement in our understanding, learning from our mistakes, an asymptotic approach to the Universe, but with the proviso that absolute certainty will always elude us.

Indeed, it is likely that we will always be mired in error. The most each generation can hope for is to reduce the error bars a little, and to add to the body of data to which error bars are attached. The error bar is a pervasive, visible self-assessment of the reliability of our knowledge. You can often see error bars in public opinion polls ("an uncertainty of plus or minus 3 percent," say). It would be a step forward were error bars or their equivalent prominently displayed in politics, economics, and religion.

One of the great commandments of science is, "Mistrust arguments from authority." Too many such arguments have proved too painfully wrong. Authorities must prove their contentions like everybody else. This independence of science, its occasional unwillingness to pay obeisance to conventional wisdom, makes it dangerous to doctrines less self-critical ^{and more absolute.} 

Because science carries us toward an understanding of how the world is, rather than how we would wish it to be, its findings may not in all cases be immediately comprehensible or satisfying. It may take a little work to restructure our mindsets. Some of science is very simple. When it gets complicated, that's usually because the world is complicated -- or because we're complicated. When we shy away from it because it seems too difficult (or because we've been taught so poorly), we surrender the ability to take charge of our future. We are disenfranchised. Our self-confidence erodes.

But when we pass beyond the barrier, when the findings and methods of science get through to us, when we understand and put this knowledge to use, many feel, if not always wild exhilaration, at least deep satisfaction. This is true for everyone, but especially for children -- born with a zest for knowledge, aware that they must live in a future molded by science, but so often convinced in their adolescence that science is not for them. I know personally, both from having science explained to me and from my attempts to explain it to others, how gratifying it is when we get it, when obscure terms suddenly take on meaning, when we grasp what all the fuss is about, when wonders are revealed. ~~We're reassured and empowered: We're not so stupid after all. We can have something to say about the decisions that determine our future.~~

~~And we're moved -- because~~ in its encounter with Nature, science invariably conveys a sense of reverence and awe. The very act of understanding is a celebration of joining, merging, even if on a very modest scale, with the magnificence of the Cosmos. And the cumulative build-up of knowledge over time converts science into something like a trans-national, trans-generational meta-mind.

"Spirit" comes from the Latin word "to breathe." What we breathe is air, which is certainly matter. So there should be no implication in the word "spiritual" that we are talking of anything other than matter, anything ^{outside the realm of} ~~foreign to~~ science. On

occasion, I will feel free to use the word. Science is not only compatible with spirituality; it is a profound source of spirituality. When we recognize our place in an immensity of light years and in the course of ages, when we grasp the intricacy, beauty, and subtlety of life, that soaring feeling, that sense of elation and humility combined, is spiritual. So are our emotions in the presence of great art or music or literature, or in the presence of acts of exemplary selfless courage such as those of Mohandas Gandhi or Martin Luther King, Jr. The notion that science and spirituality are somehow mutually exclusive does a disservice to both.

Being human, scientists are not perfect. New evidence, here too, is sometimes resisted when it challenges favored doctrines. Scientists have, both inadvertently and intentionally, developed formidable, indeed mythic, powers of destruction. The technological perils that science serves up, its implicit challenge to received wisdom, and its perceived difficulty, are all reasons for some people to mistrust and avoid it. You can see the disquiet easily enough in the image of the mad scientist on Saturday morning children's television -- or in the plethora of Faustian bargains in popular culture, from the eponymous Dr. Faustus himself to Dr. Frankenstein, Dr. Strangelove, and Jurassic Park.

* * *

[12-11-94.at1]

Insert L, Ch 1, p. 9

~~An insert into The Demon-Haunted World:~~

You can go to the witch doctor to have the spell lifted that causes your pernicious anemia ~~[check]~~, or you can take vitamin B12 [check]. ~~You can hope your children won't be infected by diphtheria, or you can have them inoculated.~~

Science may be hard to understand. It may challenge cherished beliefs. When its products are placed at the disposal of politicians or industrialists, it may lead to weapons of mass destruction and grave threats to the environment. But one thing you have to say about science: It delivers the goods.

If you want to know when the next eclipse of the Sun will be, you might try magicians or mystics, but you'll do much better with scientists. *They can predict a solar eclipse to the minute a millennium in advance.* *They can predict when an eclipse will happen, how long it'll last, and where on Earth you should be standing to get a good look -- and with an accuracy of seconds [check] from a distance of centuries.* *Smart!* If you want to save your child from polio, you can pray or you can inoculate. *Bob: op?* If you're interested in the sex of your unborn child, you can consult plumb-bob danglers all you want,* but they'll be right, on average, only one time in two. If you want real accuracy (here, 99 percent accuracy), try science.

Think of how many religions attempt to validate themselves with prophecy. Think of how many people rely on these prophecies, however vague, however unfulfilled, to support or prop up their beliefs. Yet has there ever been a religion with the prophetic accuracy and reliability of science? There isn't a

~~He was sure~~

*The late film actor Cary Grant supported himself in this way as a young man. "Left-right, a boy," he once told Ann Druyan and me, "forward-back, a girl." He and his carnival were long gone by the time the baby was born.

religion on the planet that doesn't long for a comparable ability -- precise, and repeatedly demonstrated before committed skeptics -- to prophesize future events. No other human institution comes close.

What is the secret of its success? Partly, it's that built-in error-correcting machinery. There are no forbidden questions in science, no matters too sensitive or delicate to be probed, no sacred truths. That openness to new ideas, combined with the most rigorous, skeptical scrutiny of all ideas, sifts the wheat from the chaff. It makes no difference how smart, august, or beloved you are. You must prove your case in the face of determined, expert criticism. Diversity and debate are valued. Opinions are encouraged to contend -- substantively and in depth.

The process of science may sound messy and disorderly. In a way, it is. If you examine science in its everyday aspect, of course you find that scientists run the gamut of human emotions, personalities, and character. But there's one facet that is really striking to the outsider, and that is the gauntlet of criticism which is considered acceptable or even desirable. The poor graduate student at his or her Ph.D. oral exam is subjected to a withering crossfire of questions from the very professors who have the candidate's future in their grasp. Naturally the students are nervous; who wouldn't be? True, they've prepared for it for years. But they understand that at this critical moment, they have to be able to answer questions in depth. So in

preparing to defend their theses, they must practice a very useful habit of thought: They must anticipate questions; they have to ask, Where in my dissertation is there a weakness that someone else might find? I'd better find it before they do.

You sit in at contentious scientific meetings. You find university colloquia in which the speaker has hardly gotten 30 seconds into the talk when there are devastating questions and comments from the audience. You examine the publication conventions in which a written report is submitted to a scientific journal, then is conveyed by the editor to anonymous referees whose job it is to think, Did the author do anything stupid? If not, is there anything in here that is sufficiently interesting to be published? What are the deficiencies of this paper? Have the main results been found by anybody else? Is the argument adequate, or should the paper be resubmitted after the author has actually demonstrated what is here only speculated on? And so on. And it's anonymous: The author does not know who the critics are. This is the everyday expectation in the scientific community. Those who don't expect it -- even good scientists who just can't hold up to criticism -- often have difficult careers.

Why do we put up with it? Do we like to be criticized? No, no scientist enjoys it. Every scientist feels a proprietary affection for his or her ideas and scientific results. Even so, you don't reply to critics, Wait a minute; this is a really good idea; I'm very fond of it; it's done you no harm; please leave it

alone. Instead, the hard but just rule is that if the ideas don't work, you must throw them away. Don't waste neurons on what doesn't work. Devote those neurons to new ideas that better explain the data. Valid criticism does you a favor.

Some people consider science arrogant -- especially when it purports to contradict beliefs of long standing or when it introduces bizarre concepts that seem contradictory to common sense. Like an earthquake that rattles our faith in the ground we're standing on, challenging our accustomed beliefs, shaking the doctrines we have grown to rely upon, can be profoundly disturbing. Nevertheless, I maintain that science is part and parcel humility. Scientists do not seek to impose their needs and wants on Nature, but instead humbly try to interrogate Nature and to take seriously what they find. We are aware that revered scientists have been wrong. We understand human imperfection. We insist on independent and -- to the extent possible -- quantitative verification of proposed tenets of belief. We are constantly prodding, challenging, seeking contradictions or small, persistent residual errors, proposing alternative explanations, encouraging heresy. We give our highest rewards to those who convincingly disprove established beliefs.

Here's one of many examples: The laws of motion and the inverse square law of gravitation associated with the name of Isaac Newton are properly considered among the crowning intellectual achievements of the human species. Three hundred

years later we use Newtonian dynamics to predict those eclipses. ~~I'm routinely involved with spacecraft missions to distant planets.~~ Years after launch, billions of miles from Earth, the spacecraft beautifully arrives at a predetermined place in the orbit of the target world, just as the world comes ambling by. The accuracy is astonishing. Plainly, Newton knew what he was doing.

But scientists have not been content to leave well enough alone. They have persistently sought chinks in the Newtonian armor. At high speeds and strong gravities, Newtonian physics breaks down. This is one of the great findings of Albert Einstein's Special and General Relativity, and is one of the reasons his memory is so greatly honored. Newtonian physics is valid over a range of conditions corresponding to those of everyday life. But in certain circumstances highly unusual for human beings -- we are not in the habit of travelling, say, near light speed -- it simply doesn't ^{give the right answer; it does not conform to ob-}work. Special and General ^{are indistinguishable from} Relativity ^{are indistinguishable from} ~~reduce to~~ Newtonian physics in its realm of validity, ^{of Nature.} but make very different predictions -- predictions in excellent accord with observation -- in those other regimes (high speed, strong gravity). Newtonian physics turns out to be an approximation to the truth, good in circumstances with which we are routinely familiar, bad in others. It is a splendid and ^{has its limitations} justly celebrated achievement of the human mind, but it is ~~imperfect.~~

However, in accord with our understanding of human fallibility, heeding the counsel that we may asymptotically approach the truth but will never fully reach it, scientists are today investigating regimes in which General Relativity may break down. For example, General Relativity predicts a startling phenomenon called gravitational waves. They have never been detected directly. But if they do not exist, there is something fundamentally wrong with General Relativity. Pulsars are rapidly rotating neutron stars whose flicker rates can now be measured to ten or more decimal places. Two very dense pulsars in orbit around each other are predicted to radiate copious quantities of gravitational waves -- which will in time slightly alter the orbits and rotation periods of the two stars. Joseph Taylor and [TK] of Princeton University have used this method to test the predictions of General Relativity in a wholly new way. For all they knew, the results would be inconsistent with General Relativity and they would have overturned one of the chief pillars of modern physics. Not only were they willing to challenge General Relativity, they were widely encouraged to do so. As it turns out, the observations of binary pulsars give a precise verification of the predictions of General Relativity, and for this Taylor and [TK] were co-recipients of the 1993 Nobel Prize in Physics. In diverse ways, many other physicists are testing General Relativity -- for example by attempting directly to detect the elusive gravitational waves. They hope to strain

the theory to the breaking point and discover whether a regime of Nature exists in which Einstein's great advance in understanding begins to fray.

These efforts will continue as long as there are scientists. General Relativity is certainly an inadequate description of Nature at the quantum level, but even if that were not the case, even if General Relativity were everywhere and forever valid, what better way of convincing ourselves of its validity than a concerted effort to discover its failings and limitations?

This is one of the reasons that the bureaucratic religions do not inspire me with confidence. Which leaders of the major faiths acknowledge that their beliefs might be incomplete or erroneous and establish institutes to uncover the doctrinal deficiencies? Who is testing the ^{*Circumstances in which traditional*} ~~regime of breakdown of~~ ^{*may no longer apply?*} religious teachings? (It is certainly conceivable that doctrines and ethics which may have worked fairly well in patriarchal or patristic or medieval times might be thoroughly invalid in the very different world we inhabit today.) What sermons even-handedly examine the God hypothesis? What rewards are religious skeptics given by the established religions -- or, for that matter, social and economic skeptics by the society in which they swim? *"Remember, you're very young. You've been wrong before."*

Science, Ann Druyan notes, is forever whispering in our ears, "You might be wrong. ~~You might be wrong. You might be wrong.~~ . . ." Despite all the talk of humility, show me something

comparable in religion. Scripture is said to be divinely inspired, but what if it's not? What if it's simply made up by fallible humans? Miracles are attested, but what if they're instead some mix of charlatanry, unfamiliar states of consciousness, misapprehensions of natural phenomena, and mental illness? No contemporary religion and no New Age belief seems to me to take sufficient account of the grandeur, magnificence, subtlety, and intricacy of the Universe revealed by science. The fact that so little of the findings of modern science is prefigured in Scripture to my mind casts further doubt on its divine inspiration.

But of course I might be wrong.

* * *

It is known that Maxwell's electrodynamics -- as usually understood at the present time -- when applied to moving bodies, leads to asymmetries which do not appear to be inherent in the phenomena. Take, for example, the reciprocal electrodynamic action of a magnet and a conductor. The observable phenomenon here depends only on the relative motion of the conductor and the magnet, whereas the customary view draws a sharp distinction between the two cases in which either the one or the other of these bodies is in motion. For if the magnet is in motion and the conductor at rest, there arises in the neighbourhood of the magnet an electric field with a certain definite energy, producing a current at the places where parts of the conductor are situated. But if the magnet is stationary and the conductor in motion, no electric field arises in the neighbourhood of the magnet. In the conductor, however, we find an electromotive force, to which in itself there is no corresponding energy, but which gives rise -- assuming equality of relative motion in the two cases discussed -- to electric currents of the same path and intensity as those produced by the electric forces in the former case.

Examples of this sort, together with the unsuccessful attempts to discover any motion of the earth relative to the "light medium," suggest that the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest. They suggest rather that, as has already been shown to the first order of small quantities, the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good.

What is the author trying to tell us here? I'll try to explain the background later in this book. For now, we can perhaps recognize that the language is spare, technical, cautious, clear, and not a jot more complicated than it needs to be. You would not offhand guess from how it's phrased (or from its unostentatious title, "On the Electrodynamics of Moving Bodies") that this article represents the crucial arrival of the theory of Special Relativity into the world ~~of physics~~, the gateway to the triumphant announcement of the equivalence of mass and energy, and in several different ways an epochal event in human history. The opening words of Albert Einstein's 1905 paper are characteristic of the scientific report. It is refreshingly unselfserving, circumspectly nonhyperbolic. Contrast its restrained tone with, say, the products of modern advertising, political speeches, religious pronouncements -- or for that matter the blurb on the cover of this book.

Notice how Einstein's paper begins by trying to make sense of experimental results. Wherever possible, scientists experiment. They do not trust what is intuitively obvious. That the Earth is flat was once obvious. That heavier bodies fall

faster than lighter ones was once obvious. That blood-sucking leeches cure disease was once obvious. That some people are naturally and by divine decree slaves was once obvious. That there is such a place as the center of the Universe, and that the Earth sits in that very spot was once obvious. That there is an absolute standard of rest was once obvious. The truth may be puzzling or counterintuitive; and it may contradict deeply held beliefs. Experiment is how we find it.

At a dinner many decades ago, the physicist Robert W. Wood was asked to respond to the toast, "To physics and metaphysics." By "metaphysics," people then meant something like philosophy, or truths you could recognize just by thinking about them. They could also have included pseudoscience. Wood answered along these lines:

The physicist has an idea. The more he thinks it through, the more sense it seems to make. He consults the scientific literature. The more he reads, the more promising the idea becomes. Thus prepared, he ^{goes to the laboratory and} devises an experiment to test it. The experiment is painstaking. Many possibilities are checked. The accuracy of measurement is refined, the error bars reduced. ^{But} At the end of all this work, ~~though~~, through careful experimentation, the idea is found to be worthless. So the physicist discards it, frees his mind from the clutter of error, and moves on to something else.

He lets the chips fall where they may. He is devoted only to what the experiment teaches.

The difference between physics and metaphysics, Wood concluded, is not that the practitioners of one are smarter than the practitioners of the other. The difference is that the metaphysicist has no laboratory.

* * *

For me, there are four main reasons for a concerted effort to convey science -- in radio, TV, movies, newspapers, books, computer programs, theme parks, and classrooms -- to every citizen. In all uses of science, it is insufficient -- indeed it is dangerous -- to produce only a small, highly competent, well-rewarded priesthood of professionals. Instead, some fundamental understanding of the findings and methods of science must be available on the broadest scale:

Science is the golden road out of poverty and backwardness for emerging nations. It makes national economies and the global civilization run. Many nations understand this. It is why so many graduate students in science and engineering at American universities -- still the best in the world -- are from other countries. The corollary, one that the United States sometimes fails to grasp, is that abandoning science is the road back into poverty and backwardness.

Science alerts us to the perils introduced by our world-altering technologies, especially to the global environment on

which our lives depend. Science provides an essential early warning system.

Science teaches us about the deepest issues of origins, natures, and fates -- of our species, of life, of our planet, of the Universe. For the first time in human history we are able to secure a real understanding of some of these matters. Every culture on Earth has addressed such issues and valued their importance. All of us feel goosebumps as we approach these grand questions. In the long run, the greatest gift of science may be in teaching us, in ways no other human endeavor has been able, something about our cosmic context, about where, when, and who we are.

The values of science and the values of democracy are concordant, in many cases indistinguishable. Science and democracy began -- in their civilized incarnations at least -- in the same time and place, Greece in the seventh and sixth

centuries B.C. Science confers power on anyone who takes the trouble to learn it, *(although too many have been systematically prevented from doing so.)* Science thrives on the free exchange of ideas; its values are antithetical to secrecy. Science holds to no special vantage points or privileged positions. Both science and democracy encourage unconventional opinions and vigorous debate. Both demand adequate reason, coherent argument, rigorous standards of evidence and honesty. Science is a way to call the bluff of those who only pretend to knowledge. *If we're true to its values, it can* ~~It~~ tells us when we're being lied to. It provides a mid-course correction to our

mistakes. The more widespread its language, rules, and methods, the better chance we have of preserving what Jefferson and his colleagues had in mind. But democracy can also be subverted more thoroughly through the tools of science than any pre-industrial demagogue ever dreamed.

Finding the occasional straw of truth awash in a great ocean of confusion and bamboozle requires vigilance, dedication, and courage. But if we don't practice these tough habits of thought, we cannot hope to solve the truly serious problems that face us -- and we risk becoming a nation of suckers, up for grabs by the next charlatan who saunters along.

* * *

An extraterrestrial being, newly arrived on Earth -- scrutinizing what we mainly present to our children in television, radio, movies, newspapers, magazines, the comics, and many books -- might easily conclude that we are intent on teaching them murder, rape, cruelty, superstition, credulity, and consumerism. We keep at it, and through constant repetition many of them finally get it. What kind of society could we create if, instead, we drummed into them science and a sense of hope?

[M, 11/28/94]

Chapter 2

THE MOST PRECIOUS THING

All our science, measured against reality, is primitive and childlike -- and yet it is the most precious thing we have.

-- Albert Einstein (1879-1955)

As I got off the plane, he was waiting for me, holding up a piece of cardboard with my name scribbled on it. I was on my way to a conference of scientists and TV broadcasters devoted to the seemingly forlorn prospect of improving the presentation of science on television, and the organizers had kindly sent a driver.

"Do you mind if I ask you a question?" he said as we waited for my bag.

No, I didn't mind.

"Isn't it confusing to have the same name as that scientist guy?"

It took me a moment to understand. Was he pulling my leg? Finally, it dawned on me.

"I am that scientist guy," I answered.

He paused and then smiled. "Sorry. That's my problem. I thought it was yours too."

He put out his hand. "My name is William F. Buckley."
(Well, he wasn't exactly William F. Buckley, but he did bear the name of a contentious and well-known TV interviewer, for which he

doubtless took a lot of good-natured ribbing.)

As we settled into the car for the long drive, the windshield wipers rhythmically thwacking, he told me he was glad I was "that scientist guy" -- he had so many questions to ask about science. Would I mind?

No, I didn't mind.

And so we got to talking. But not, as it turned out, about science. He wanted to talk about frozen extraterrestrials at an Air Force base near San Antonio, "channeling" (a way to hear what's on the minds of dead people -- not much, it turns out), crystals, crop circles, the prophecies of Nostradamus, astrology, the shroud of Turin. . . He introduced each portentous subject with buoyant enthusiasm. Each time I had to disappoint him:

"The evidence is crummy," I kept saying. "There's a much simpler explanation."

He was, in a way, widely-read. He knew the various speculative nuances on, let's say, the "sunken continents" of Atlantis and Lemuria. He had at his fingertips what underwater expeditions were supposedly just setting out to find the tumbled columns and broken minarets of a once-great civilization whose remains were now visited only by deep sea luminescent fish and giant kraken. Except. . . while the ocean keeps many secrets, I knew that there isn't a trace of oceanographic or geophysical support for Atlantis and Lemuria. As far as science can tell, they never existed. By now a little reluctantly, I told him so.

As we drove through the rain, I could see him getting glummer and glummer. I was dismissing not just some errant doctrine of pseudoscience, but a precious facet of his inner life.

And yet there's so much in real science that's equally exciting, more mysterious, a greater intellectual challenge -- as well as being a lot closer to the truth. Did he know about the molecular building blocks of life sitting out there in the cold, tenuous gas between the stars? Had he heard of the footprints of our ancestors found in 4-million-year-old volcanic ash? What about the raising of the Himalayas when India went crashing into Asia? Or how viruses subvert the reproductive machinery of cells, or the radio search for extraterrestrial intelligence, or the newly-discovered ancient civilization of Ebla? No, he hadn't heard. Nor did he know, even vaguely, about quantum indeterminacy, and he recognized DNA only as three frequently-linked capital letters.

Mr. "Buckley" -- well-spoken, intelligent, curious -- had heard virtually nothing of modern science. He had a natural appetite for the wonders of the Universe. He wanted to know about science. It's just that all the science had gotten filtered out before it reached him. Our cultural motifs, our educational system, our communications media had failed this man. What the society permitted to trickle through was mainly pretense and confusion. And it had never taught him how to distinguish

real science from the cheap imitation.

There are hundreds of books about Atlantis -- the mythical continent that is said to have existed something like 10,000 years ago in the Atlantic Ocean. The story goes back to Plato, who reported it as hearsay coming down to him from remote ages. Recent books authoritatively describe the high level of Atlantean technology, morals, and spirituality, and the great tragedy of an entire populated continent sinking beneath the waves. There is a "New Age" Atlantis, "the legendary civilization of advanced sciences," chiefly crystals. In a trilogy called Crystal Enlightenment, by Katrina Raphaell -- the books mainly responsible for the current crystal craze in America -- Atlantean crystals read minds, transmit thoughts, are the repositories of ancient history, and the model and source of the pyramids of Egypt. Nothing approximating evidence is offered to support these assertions.

A few books -- Dorothy Vitaliano's Legends of the Earth, for example -- sympathetically interpret the original Atlantis legends in terms of a small island in the Mediterranean that was destroyed by a volcanic eruption, or an ancient city that slid into the Aegean after an earthquake. This, for all we know, may be the source of the legend, but it is a far cry from the destruction of a continent on which had sprung forth a preternaturally advanced technical and mystical civilization.

What we almost never find -- in public libraries or newsstand magazines or prime time television programs -- is the evidence from sea floor spreading and plate tectonics, and from mapping the ocean floor which shows quite unmistakably that there could have been no continent between Europe and the Americas on anything like the timescale proposed.

Spurious accounts that snare the gullible are readily available. Skeptical treatments are much harder to find. Skepticism does not sell well. A bright and curious person who relies entirely on popular culture to be informed about something like Atlantis is hundreds or thousands of times more likely to come upon a fable treated uncritically than a sober and balanced assessment.

Maybe Mr. Buckley should know to be more skeptical about what's dished out to him by popular culture. But apart from that, it's hard to see how it's his fault. He simply accepted what the most widely available and accessible sources of information claimed was true. For his naiveté, he was systematically misled and bamboozled.

Science arouses a soaring sense of wonder. But so does pseudoscience. Sparse and poor popularizations of science abandon ecological niches that pseudoscience promptly fills. If science were explained to the average person in a way that was exciting and accessible, there would be no room for pseudoscience. But there's a kind of Gresham's Law in popular

culture by which bad science drives out good.

All over the world there are enormous numbers of smart, even gifted, people who have a built-in passion for science. But that passion is unrequited. A survey suggests that 94 percent of Americans are "scientifically illiterate."

Every generation worries that educational standards are decaying. One of the oldest short essays in human history, dating from Sumer some 4,000 years ago, laments that the young are disastrously more ignorant than the generation immediately preceding. The aging and grumpy Plato, in Book VII of the Laws, gives his definition of scientific illiteracy:

Who is unable to count one, two, three, or to distinguish odd from even numbers, or is unable to count at all, or reckon night and day, and who is totally unacquainted with the revolution of the Sun and Moon, and the other stars. . . All freemen, I conceive, should learn as much of these branches of knowledge as every child in Egypt is taught when he learns the alphabet. In that country arithmetical games have been invented for the use of mere children, which they learn as pleasure and amusement. . . I. . . have late in life heard with amazement of our ignorance in these matters; to me we appear to be more like pigs than men, and I am quite ashamed, not only of myself, but of all Greeks.

I don't know to what extent ignorance of science and mathematics contributed to the decline of ancient Athens, but I know that the consequences of scientific illiteracy are far more dangerous in our time than in any that has come before. It's dangerous and foolhardy for us to remain ignorant about global warming, say, or ozone depletion, air pollution, toxic and radioactive wastes, acid rain, topsoil erosion, tropical deforestation, exponential population growth. Jobs and wages

depend on science and technology. If our nation can't manufacture, at high quality and low price, products people want to buy, then industries will drift away and transfer a little prosperity to another part of the world. What about fission and fusion power, supercomputers, data "highways," abortion, radon, massive reductions in strategic weapons, addiction, government eavesdropping on the lives of its citizens, high-resolution TV, airline and airport safety, health costs, food additives, drugs to ameliorate mania or depression or schizophrenia, animal rights, superconductivity, morning-after pills, alleged hereditary antisocial predispositions, space stations, going to Mars, finding cures for AIDS and cancer? ^A How can we effect national policy -- or even make intelligent decisions in our own lives -- if we don't grasp the underlying issues? Of the 535 members of the U.S. Congress, rarely in the twentieth century have as many as one percent had any significant background in science. ^{The last scientifically literate president may have been Thomas Jefferson.} So how do Americans decide these matters? How do they instruct their representatives? Who in fact makes these decisions, and on what basis?

As I write, ~~the~~ Congress is considering dissolving ^{its} the Office of Technology Assessment -- the only organization specifically tasked to provide advice to the House and Senate ^{***} on science and technology. Its competence and integrity over the years ^{has} been exemplary.

Hippocrates of Cos is the father of medicine. He is still remembered 2,500 years later by the Hippocratic Oath (a modified form of which is still taken by medical students upon their

* Although Britain recently had such a prime minister in Margaret Thatcher. Her ^{early} studies in chemistry, in part under the tutelage of Nobel Laureate Dorothy Hodgkins, ^{were} key to the U.K.'s strong and successful advocacy that the ozone-depleting CFCs be banned worldwide.

graduation). But he is chiefly celebrated because of his efforts to bring medicine out of the pall of superstition and into the light of science. A similar emergence of medical science from mysticism occurred some centuries later in China under the tutelage of Bian Que. In a typical passage Hippocrates wrote: "Men think epilepsy divine, merely because they do not understand it. But if they called everything divine which they do not understand, why, there would be no end of divine things." Instead of acknowledging that in many areas we are ignorant, we tend to say things like the Universe is permeated with the ineffable. A God of the Gaps is assigned responsibility for what we do not yet understand. As knowledge of medicine improved since the fourth century B.C., there was more and more that we understood and less and less that had to be attributed to divine intervention -- either in the causes or in the treatment of disease. Deaths in childbirth and infant mortality have decreased, lifetimes have lengthened, and medicine has improved the quality of life for billions of people.

In the diagnosis of disease, Hippocrates introduced elements of the scientific method. He urged careful and meticulous observation: "Leave nothing to chance. Overlook nothing. Combine contradictory observations. Allow yourself enough time." Before the invention of the thermometer, he charted the temperature curves of many diseases. He recommended that physicians be able to tell, from present symptoms alone, the

probable past and future course of each illness. He stressed honesty. He was willing to admit the limitations of the physician's knowledge. He betrayed no embarrassment in confiding to posterity that more than half his patients were killed by the diseases he was treating. His options of course were limited; the drugs available to him were chiefly laxatives, emetics, and narcotics. Surgery was performed, and cauterization. Considerable further advances were made in classical times through the fall of Rome.

What followed was truly a dark age for medicine. Much knowledge of anatomy and surgery was lost. Reliance on prayer and miraculous healing abounded. Secular physicians became extinct. Chants, potions, horoscopes, and amulets were widely used. Dissections of cadavers were restricted or outlawed, so those who practiced medicine were prevented from acquiring firsthand knowledge of the human body. Medical research came to a standstill.

Even at its best, pre-modern medical practice did not save many. Queen Anne was the last Stuart monarch of Great Britain. In the last 17 years of the seventeenth century, she was pregnant 18 times. Only five children were born alive. Only one of them survived infancy. He died before reaching adulthood, and before her coronation in 1702. There is no evidence of some hereditary taint. She had the best medical care money could buy.

Diseases that once tragically carried off countless infants and children have been progressively mitigated and cured by science -- through the discovery of the microbial world, by the insight that physicians and ^mwidwives should wash their hands and sterilize their instruments, through public health and sanitation measures, drugs, vaccines, the uncovering of the molecular structure of DNA, molecular biology, and now gene therapy. In the developed world at least, parents today have an enormously better chance of seeing their children live to adulthood than did the heir to the throne of one of the most powerful nations on Earth in the late seventeenth century. Smallpox has been wiped out worldwide. The area of our planet infested with malaria-carrying mosquitoes has dramatically shrunk. The number of years a child diagnosed with leukemia can expect to live has been increasing progressively, year by year. Science permits the Earth to hold about a hundred times more humans, and under conditions much less grim, than it could a mere 2,000 years ago.

We can pray over the cholera victim [check], or we can give her ⁵⁰⁰ [how many?] milligrams of ^{tetracycline every 12 hours} erythromycin [check]. We can try nearly futile psychoanalytic talk therapy to the ^{anxious, manic, explosive} uncommunicative, ^{or} nearly catatonic ^{patient} schizophrenic, or we can give him ^{100 milligrams a day} [how many?] ^{chlorpromazine} milligrams of ~~phenothiazines~~. The scientific cures are hundreds or thousands of times more often effective than the alternatives. (And even when the alternatives seem to work, we don't actually know that they played any role: Spontaneous remissions, even of

cholera and schizophrenia, can occur without prayer and without psychoanalysis.) Abandoning science means abandoning much more than air conditioning, CD players, hair dryers, and fast cars.

In ancient Greece and Rome, the average human life expectancy was about 25 years. ^{Even in the last few centuries,} Raphael, Mozart, Keats, Chopin, ^{list the merest} Galois, Schubert, and Schumann -- to ~~name only a~~ handful -- all died in their ^{20s or} 30s. What contributions would they have made had they lived into their 70s? In Western Europe and ^{North America} Japan, average life expectancy reached 40 years by the early nineteenth century, and is now around 75 years (a little more for women, a little less for men). Longevity is perhaps the best single measure of the quality of life. This is a precious gift offered by science to humanity -- ^{nothing less than} the gift of life.

But microorganisms mutate. New diseases spread like wildfire. There is a constant battle between microbial measures and human countermeasures. We keep pace in this competition not just by designing new drugs and treatments, but by penetrating progressively more deeply toward an understanding of the nature of life.

If the world is to escape the direst consequences of global population growth and 10 or 12 billion people on the planet in the late twenty-first century, we must invent safe but more efficient means of growing food -- with accompanying seed stocks, irrigation, fertilizers, pesticides, transportation and refrigeration systems. It will also take widely available

contraception, significant steps toward political equality of women, and improvements in the standards of living of the poorest people. How can all this be accomplished without science and technology?

I know that science and technology are not just cornucopias pouring good deeds out into the world. Scientists not only conceived nuclear weapons; they also took political leaders by the lapels, arguing that their nation -- whichever it happened to be -- had to have one first. Then they were complicit in the manufacture of 60,000 of them. Our technology has produced thalidomide, CFCs, Agent Orange, nerve gas, and industries so powerful they can ruin the climate of the planet. There's a reason people are nervous about science and technology. And so the image of the mad scientist haunts our world -- down to the white-coated loonies of Saturday morning children's TV.

But we can't simply conclude that science puts too much power into the hands of morally feeble technologists or corrupt, power-crazed politicians and so decide to get rid of it. Advances in medicine and agriculture have saved more lives than have been lost in all the wars in history.* Advances in transportation, communication, and entertainment have transformed and unified the world. The sword of science is double-edged.

*At a dinner table recently, I asked the assembled guests -- ranging in age, I guess, from thirties to sixties -- how many would be alive today if not for antibiotics, cardiac pacemakers, and the rest of the panoply of modern medicine. Only one hand went up. It was not mine.

Its awesome power forces on all of us, including politicians, a new responsibility -- more attention to the long-term consequences of technology, a global and transgenerational perspective, an incentive to avoid easy appeals to nationalism and chauvinism. Mistakes are becoming too expensive.

True, science can be dangerous. But its absence is far more dangerous.

isn't self-knowledge
the only antidote?

* * *

Do we care what's true? Does it matter?

. . . where ignorance is bliss,
'Tis folly to be wise

wrote the poet Thomas Gray. But is it? It's disheartening to discover government corruption and incompetence, for example; but is it better not to know about it? Whose interest does ignorance serve? If we humans have ^{say,} hereditary propensities toward hatred ~~shouldn't we make sure our children know about it?~~ of strangers, ~~say, are we better off without such self-knowledge?~~ If we long to believe that the stars rise and set for us, that we are the reason there is a Universe, does science do us a disservice in deflating our conceits?

In The Genealogy of Morals, Friedrich Nietzsche, as so many before and after, decries the "unbroken progress in the self-belittling of man" brought about by the scientific revolution. Sounding like a dejected imperialist sent packing by his former colonial subjects, Nietzsche mourns the loss of "man's belief in

his dignity, his uniqueness, his irreplaceability in the scheme of existence." For me, it is far better to grasp the Universe as it really is than to persist in delusion, however satisfying and reassuring. Which attitude is better geared for our long-term survival? Which gives us more leverage on our future? And if our naive self-confidence is a little undermined in the process, is that altogether such a loss? Is there not cause to welcome it as a maturing and character-building experience?

To discover that the Universe is some 15 billion and not 6,000 years old improves our appreciation of its sweep and grandeur; to entertain the notion that we are a particularly complex arrangement of atoms, and not some breath of divinity, at the very least enhances our respect for atoms; to discover, as now seems probable, that our planet is one of billions of other worlds in the Milky Way Galaxy and that our galaxy is one of billions more, majestically expands the arena of what is possible; to find that our ancestors were also the ancestors of apes ties us to the rest of life and makes possible useful -- if not wholly uplifting -- insights into human nature.

Plainly there is no way back. Like it or not, we are stuck with science. We had better make the best of it. When we finally come to terms with it and fully recognize its beauty and its power, we will find, in spiritual as well as in practical matters, that we have made a bargain strongly in our favor.

But pseudoscience keeps getting in the way, distracting all the "Buckleys" among us, providing easy answers, casually pressing our awe buttons and cheapening the experience, making us routine and comfortable practitioners as well as victims of credulity. Yes, the world would be a more interesting place if there were UFOs lurking in the deep waters off Bermuda and eating ships and planes, or if dead people could take control of our hands and write us messages. It would be fascinating if adolescents were able to make telephone handsets rocket off their cradles just by thinking at them, or if our dreams could, more often than can be explained by chance and our knowledge of the world, accurately foretell the future.

These are all instances of pseudoscience. The contentions purport to use the methods and findings of science, while in fact they are faithless to its nature -- often because they are based on insufficient evidence or because they ignore clues that point the other way. With the uninformed cooperation (and occasionally the cynical connivance) of newspapers, magazines, book publishers, radio, television, movie producers, and the like, such ideas are easily and widely available. Far more difficult to come upon, as I was reminded by my encounter with Mr. "Buckley," are the alternative, more challenging and even more dazzling findings of science.

Pseudoscience is easier to contrive than science, because distracting confrontations with reality -- where we cannot

control the outcome of the comparison -- are more readily avoided. The standards of argument, what passes for evidence, are much more relaxed. In part for these same reasons, it is much easier to present pseudoscience to the general public than science. But this isn't enough to explain its popularity.

Naturally people try various belief systems on for size, to see if they help. And if we're desperate enough, we become all too willing to abandon what may be perceived as the heavy burden of skepticism. Pseudoscience speaks to powerful emotional needs that science often leaves unfulfilled. It caters to fantasies about personal powers we lack and long for (like those attributed to comic book superheroes today, and earlier, to the gods). In some of its manifestations, it offers satisfaction of spiritual hungers, claims to cure disease, promises that death is not the end, and reassures us of our cosmic centrality and importance. It vouchsafes that we are hooked up with, tied to the Universe.** Sometimes it's a kind of halfway house between old religion and new science, mistrusted by both.

At the heart of some pseudoscience (and some religion also, New Age and Old) is the idea that wishing makes it so. How satisfying it would be, as in folklore and children's stories, to

^{modern}
**Although it's hard for me to see a ^{more} profound cosmic connection than the astonishing findings of nuclear astrophysics: Except for hydrogen, all the atoms that make each of us up -- the iron in our blood, the calcium in our bones, the carbon in our brains -- were manufactured in red giant stars thousands of light years away in space and billions of years ago in time. We are, as I like to say, starstuff.

fulfill our heart's desire just by wishing. How seductive this notion is, especially when compared with the hard work and good luck usually required to achieve our hopes. The enchanted fish or the genie from the lamp will grant us three wishes -- anything we want except more wishes. Who has not pondered -- just to be on the safe side, just in case we ever accidentally rub an old, squat brass oil lamp -- what to ask for?

I remember, from childhood comic strips and books, a top-hatted, mustachioed magician who brandished an ebony walking stick. His name was Zatara. He could make anything happen, anything at all. How did he do it? Easy. He uttered his commands backwards. So if he wanted a million dollars, he would say "sralloed noillim a em evig." That's all there was to it. It was something like prayer, but much surer of results.

I spent a lot of time at age eight experimenting in this vein, commanding stones to rise up in the air: "esir, enots." It never worked. I blamed my pronunciation.

* * *

Pseudoscience is embraced, it might be argued, in exact proportion as real science is misunderstood -- except that the language breaks down here. If you've never heard of science (or at least how it works), you can hardly be aware you're embracing pseudoscience. You're simply thinking in one of the ways that

humans always have. Religions are often the state-protected nurseries of pseudoscience, although there's no reason why religions have to play that role. In a way, it's an artifact from times long gone. In some countries nearly everyone believes in astrology and precognition, including government leaders. But this is not simply drummed into them by religion; it is drawn out of the enveloping culture in which everyone is comfortable with these practices, and affirming testimonials are everywhere.

Most of the case histories I will relate in this book are American -- not because pseudoscience and mysticism are more prominent in the United States than elsewhere, but because these are the cases I know best. The psychic spoonbender and extraterrestrial channeler Yuri Geller hails from Israel. As tensions rise between Algerian secularists and Moslem fundamentalists, more and more people are discreetly making their way to the country's 10,000 soothsayers and clairvoyants (about half of whom operate with a license from the government). High French officials, including a former President of France, arranged for millions of dollars to be invested in a scam (the Elf-Aquitaine scandal) to find new petroleum reserves from the air. In Germany, there is concern about carcinogenic "Earth rays" undetectable by science; they can be detected only by experienced dowzers brandishing forked sticks. Ghosts are something of a national obsession in Britain. In Thailand, diseases are treated with pills manufactured from pulverized

^{the} Under ⁵ Tsar~~ism~~, ~~a~~ religious superstition was encouraged, but scientific and skeptical thinking -- except by a few ^{same} ~~time~~ ¹ scientists -- ruthlessly suppressed.

["The Most Precious Thing" (M, 11/28/94)]

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sacred Scripture. Astrology is rife in India, geomancy widespread in China.

Russia is an instructive case. Under Communism, both religion and pseudoscience were systematically suppressed -- except for the superstition of the state ideological religion. It was advertised as scientific, but fell as far short of this ideal as the most unselfcritical mystery cult. As a result, post-Communism, many ^{Russians} ~~people~~ view science with suspicion. Critical thinking -- except by scientists in hermetically sealed compartments of knowledge -- was recognized as dangerous, was not taught in the schools, and was punished where expressed. When the lid was lifted, though, ^{as was also true of} ~~like~~ virulent ethnic hatreds, what had all along been bubbling subsurface was revealed to view. The region is now awash in UFOs, poltergeists, faith healers, magic waters, and old-time superstition. As I write, the electorally most popular member of the Duma, a leading supporter of the ultranationalist Vladimir Zhirinovsky, is one Anatoly Kashpirovsky -- a faith healer who remotely cures diseases ranging from hernias to AIDS by glaring at you out of your television set. His face also starts stopped clocks.

Psychics ply their wares on television commercials, personally endorsed by entertainers. In America a million people a year sign on and use such guidance in their everyday lives. For the CEOs of major corporations, for financial analysts, for lawyers and bankers there is a species of

astrologer/soothsayer/psychic ready to advise on any matter. "If people knew how many people, especially the very rich and powerful ones, went to psychics, their jaws would drop through the floor," says a psychic from Cleveland, Ohio. Royalty has traditionally been vulnerable to soothsayers and psychic frauds. In ancient China and Rome astrology was the exclusive property of the emperor; any private use of this potent art was considered a capital offense. Unknown to the voting public, Nancy and Ronald Reagan relied on an astrologer in private and public matters. Some portion of the decision-making that influences the future is plainly in the hands of charlatans. If anything, the practice is comparatively muted in America; it's venue is worldwide.

Pseudoscience is often distinguishable from erroneous science. Science thrives on errors, cutting them away one by one. False conclusions are drawn all the time, but they are drawn tentatively. Hypotheses are framed so that they are capable of being disproved. A succession of alternative hypotheses is confronted with experiment and observation. Science gropes and staggers toward improved understanding. Proprietary feelings are of course offended when a scientific hypothesis is disproved, but such disproofs are considered central to the scientific enterprise.

Pseudoscience is just the opposite. Hypotheses are often framed precisely so they are invulnerable to any experiments that offer a prospect of disproof. Practitioners are defensive and

wary. Experiments are avoided. Skeptical scrutiny is opposed. When the pseudoscientific hypothesis fails to catch fire with scientists, conspiracies to suppress the evidence are readily deduced.

Perhaps the sharpest distinction between science and pseudoscience is that science has a far keener appreciation of human imperfections and fallibility than does pseudoscience. If we resolutely refuse to acknowledge where we are liable to fall into error, then we can confidently expect that error -- even serious error, profound mistakes -- will be our companion forever. But if we are capable of a little courageous self-assessment, whatever rueful reflections they may generate, our chances improve enormously.

Motor ability in healthy people is almost perfect. We rarely stumble and fall, except in young and old age. We can learn tasks such as riding a bicycle or skating or skipping, jumping rope or driving a car, and retain that mastery for the rest of our lives. Even if we've gone a decade without doing it, it comes back to us effortlessly. Our motor skills and precision may, however, give us a false sense of confidence in ^{our} other ~~activities~~ ^{+ talents.} Our perceptions are fallible. We sometimes see what isn't there. We are prey to optical illusions. Occasionally we hallucinate. In figuring things out we are error-prone. A most illuminating book called How We Know What Isn't So: The Fallibility of Human Reason in Everyday Life, by Thomas Gilovich,

shows how people systematically err in understanding random sequences of numbers, in rejecting unpleasant evidence, in being influenced by the opinions of others. We're good in some things, but not in everything. Wisdom lies in understanding our limitations. That's where the stuffy skeptical rigor of science comes in.

* * *

Each field of science has its own complement of pseudoscience. Geophysicists have flat Earths, hollow Earths, Earths with wildly bobbing axes to contend with, plus rapidly rising and sinking continents. Botanists have plants whose passionate emotional lives can be monitored with lie detectors, anthropologists have surviving ape-men, zoologists have surviving dinosaurs, and evolutionary biologists have Biblical literalists snapping at their flanks. Archaeologists have ancient astronauts, forged runes, and spurious statuary. Physicists have perpetual motion machines, an army of amateur relativity disprovers, and perhaps cold fusion. Chemists still have alchemy. Psychologists have much of psychoanalysis and almost all of parapsychology. Economists have long-range economic forecasting. Meteorologists, so far, have long-range weather forecasting, as in ^{the sunspot-oriented} ~~The~~ Farmer's Almanac (although long-term climate forecasting is another matter). Astronomy has, as its

most prominent pseudoscience, astrology -- the discipline out of which it emerged. (The pseudosciences sometimes intersect -- as in ^{telepathic} ~~parapsychological~~ searches for buried ^{From Atlantis} ~~archeological~~ treasures, or astrological economic forecasting.)

channeling UFO occupants,

But because I mainly work with planets, and because I've been interested in the possibility of extraterrestrial life, the pseudosciences that most often park themselves at my doorstep involve other worlds and what we have come so easily in our time to call "aliens." In the chapters immediately following, I want to lay out two recent, somewhat related pseudoscientific doctrines. They share the possibility that human perceptual and cognitive imperfections play a role in deceiving us on matters of great import. The first contends that a giant stone face from ages past is staring expressionlessly up at the sky from the sands of Mars. The second maintains that alien beings from distant worlds visit the Earth with casual impunity.

Even when summarized so baldly, isn't there a kind of thrill in contemplating these claims? What if such hoary science fiction ideas -- resonant surely with deep human fears and longings -- actually were coming to pass? Whose interest can fail to be aroused? Immersed in such material, even the crassest cynic finds long-forgotten little tremors of wonder bursting into consciousness. Are we absolutely sure -- beyond a shadow of a doubt -- that we can dismiss these claims? And if hardened debunkers can sense the appeal, what must those untutored in scientific skepticism, like Mr. "Buckley," feel?

✓ ✓

[M, 11/28/94]

Chapter 3

THE MAN IN THE MOON AND THE FACE ON MARS

The moon leaps
In the Great River's current. . .
Floating on the wind,
What do I resemble?

-- Du Fang, "Traveling at Night" (China, Tang Dynasty,
765)

For most of history -- before spacecraft, before telescopes, before we had begun to emerge from magical thinking -- the Moon was an enigma. No one thought of it as a world.

What do we actually see when we look up at the Moon with the naked eye? We make out a configuration of irregular bright and dark markings -- not a close representation of any familiar object. But, almost irresistibly, our eyes connect the markings, emphasizing some, ignoring others. We seek a pattern, and we find one. In world myth and folklore, many images are seen: a woman weaving, stands of laurel trees, an elephant jumping off a cliff, a girl with a basket on her back, a rabbit, the lunar intestines spilled out on its surface after evisceration by an irritable flightless bird, a woman pounding tapa cloth, a four-eyed jaguar. People of one culture have trouble understanding how such bizarre things ^{could} ~~can~~ be seen by the people of another.

The most common image is the Man in the Moon. Of course, it doesn't really look like a man. Its features are lopsided,

warped, drooping. There's a beefsteak or something over the left eye. And what expression does that mouth convey? An "O" of surprise? A hint of sadness, even lamentation? Rueful recognition of the character of life on Earth, as viewed from above? Certainly the face is too round. The ears are missing. I guess he's bald on top. Nevertheless, every time I look at it, I see a human face.

World folklore depicts the Moon as something not mysterious, but prosaic. In the pre-Apollo generation, children were told that the Moon was made of green (that is, smelly) cheese, and for some reason this was thought not marvellous but hilarious. In children's books and editorial cartoons, the Man in the Moon is often drawn simply as a face set in a circle, not too different from the bland "happy face" of a pair of dots and an upturned arc. Benignly, he looks down on the nocturnal frolics of animals and children, of the knife and the spoon.

Consider again the two categories of terrain we recognize when we examine the Moon with the naked eye: the brighter forehead, cheeks, and chin; and the darker eyes and mouth. Through a telescope, the bright features are revealed to be ancient cratered highlands, dating back, we now know, to almost 4.5 billion years ago. The dark features are somewhat younger flows of basaltic lava called maria (singular, mare -- both from the Latin word for ocean, although the Moon, we now know, is dry as a bone). The maria welled up in the first few hundred million

years of lunar history, partly induced by the high-speed impact of enormous asteroids and comets. The right eye is Mare Imbrium, the beefsteak drooping over the left eye is the combination of Mare Serenitatis and Mare Tranquillitatis (where Apollo 11 landed), and the off-center open mouth is Mare Humorum. (No craters can be made out by ordinary, unaided human vision.)

The Man in the Moon is in fact a record of ancient catastrophes -- all of which took place before humans, before mammals, before vertebrates, before multicelled organisms, and probably even before life arose on Earth. It is a characteristic conceit of our species to put a human face on random cosmic violence.

* * *

Humans, like other primates, are a gregarious lot. We enjoy one another's company. We're mammals, and parental care of the young is essential for the continuance of the hereditary lines. The parent smiles at the child, the child smiles back, and a bond is forged or strengthened. As soon as the infant can see, it recognizes faces, and we now know that this skill is hardwired in our brains. Those infants who a million years ago were unable to recognize a face smiled back less, were less likely to win the hearts of their parents, and less likely to prosper. These days, nearly every infant is quick to identify a human face, and to

respond with a goony grin.

As an inadvertent side effect, the pattern-recognition machinery in our brains is so efficient in extracting a face from a clutter of other detail that we sometimes see faces where there are none. We assemble disconnected patches of light and dark and unconsciously try to see a face. The Man in the Moon is one result. Michelangelo Antonioni's film "Blowup" describes another. There are many other examples.

Sometimes it's a geological formation, such as the Old Man of the Mountain at Franconia Notch, New Hampshire. We recognize that, rather than some supernatural agency or an otherwise undiscovered ancient civilization in New Hampshire, this is the product of erosion and collapse of a rock face. Anyway, it doesn't look much like a face anymore. There's the Devil's Head in North Carolina, the Sphinx Rock in Wastwater, England, the Old Woman in France, the Vartan Rock in Armenia. Sometimes it's a reclining woman, as Mt. Ixtaccihuatl in Mexico. Sometimes it's breasts, as the Grand Tetons in Wyoming -- mountain peaks named

by French explorers. Sometimes it's changing patterns in the

In late medieval and Renaissance Spain, visions of the Virgin Mary were "confirmed"

clouds. (While sailing out of Suva, Fiji, I once saw the head of

a truly terrifying monster, jaws agape, set in a brooding storm

cloud.)

Seeing

when people could see saints in cloud forms.

Occasionally, a vegetable or a pattern of wood grain or the hide of a cow resembles a human face. There is a celebrated eggplant that closely resembles Richard M. Nixon. What shall we

deduce from this fact? Divine or extraterrestrial intervention? Republican meddling in eggplant genetics? No. We recognize that there are large numbers of eggplants in the world and that, given enough of them, sooner or later we'll come upon one that looks like a human face, even a very particular human face.

When the face is of a religious personage -- as, for example, a tortilla purported to exhibit the face of Jesus -- believers tend quickly to deduce the hand of God. In an age more skeptical than most, they crave reassurance. Still, it seems unlikely that a miracle is being worked on so evanescent a medium. Considering how many tortillas have been pounded out since the beginning of the world, it would be surprising if a few didn't have at least vaguely familiar features.*

Magical properties have been ascribed to ginseng and mandrake roots, in part because of vague resemblances to the human form. Some chestnut shoots show smiling faces. Some corals look like hands. The ear fungus (also unpleasantly called "Jew's ear") indeed looks like an ear, and something rather like enormous eyes can be seen on the wings of certain moths. Some of this may not be mere coincidence; plants and animals that suggest a face may be less likely to be gobbled up by creatures with

*These cases are very different from that of the so-called Shroud of Turin, which shows something too close to a human form to be a misapprehended natural pattern and which is now proved by carbon-14 dating to be not the death shroud of Jesus, but a pious hoax from the fourteenth century -- a time when the manufacture of fraudulent religious relics was a thriving and profitable home handicraft industry.

faces -- or creatures who are afraid of predators with faces. (I described a case where artificial selection may have generated a human face on the carapace of the Japanese Heike crab in Cosmos.)

A "walking stick" is an insect spectacularly well disguised as a twig. Naturally, it tends to live on and around trees. Its mimicry of the plant world saves it from birds and other predators, and is almost certainly the reason that its extraordinary form was slowly molded by Darwinian natural selection. A South African orchid resembles the female of the insect that pollinates it, bent over in an enticing sexual posture; the near-sighted males, who emerge from the ground before the females, engage in an orgiastic frenzy which does them no good whatever in propagating their hereditary lines, but which is essential for orchid reproduction. The male's sexual passion has permitted him to be manipulated and subverted by a flower. Such crossings of the boundaries between kingdoms of life are somehow unnerving. A young child viewing a walking stick can easily imagine an army of sticks, branches, and trees marching for some ominous planty purpose. But when we witness or imagine the natural processes of pretechnological Nature generating a human form, we are not often disturbed. Instead, it seems to confirm our importance, and we greet it almost reverentially.

Many instances of this sort are described and illustrated in a 1979 book called Natural Likeness, by John Michell, a British enthusiast of the occult. He takes seriously the work of Richard

Shaver, who played an important role in the origin of the UFO excitement in America. Shaver cut open rocks on his Wisconsin farm and discovered, written in a pictographic language that only he could see and understand, a comprehensive history of the world. Michell accepts at face value the claims of the dramatist and Surrealist theoretician Antonin Artaud, who, in part under the influence of peyote, saw in the patterns on the outsides of rocks erotic images, a man being tortured, ferocious animals, and the like. "The whole landscape revealed itself," Michell says, "as the creation of a single thought." ^{But was that thought inside or outside Artaud's head?} Artaud concluded, and Michell agrees, that the patterns so apparent in the rocks were manufactured by an ancient civilization, rather than by Artaud's partly hallucinogen-induced altered state of consciousness. When Artaud returned from Mexico to Europe, he was diagnosed as mad. Michell decries the "materialist outlook" that ^{greeted} ~~treated~~ Artaud's patterns skeptically.

Michell shows us an x-ray photograph of the Sun which looks ^{vaguely} ~~a little~~ like a face and informs us that "followers of Gurdjieff see the face of their Master" in the solar corona. Innumerable faces in trees, mountains, and boulders all over the world are inferred to be the product of ancient wisdom. Perhaps some are: It's a good practical joke, as well as a tempting religious symbol, to pile stones so they look from afar like a giant face. ^{The view} That most of these forms are patterns natural to rock-forming processes and the bilateral symmetry of plants and

animals, plus a little natural selection -- all processed through the human-biased filter of our perception -- Michell describes as "materialism" and a "nineteenth-century delusion." "Conditioned by rationalist beliefs, our view of the world is duller and more confined than nature intended." By what process he has plumbed the intentions of Nature is not revealed.

Of the images he presents, Michell concludes that

their mystery remains essentially untouched, a constant source of wonder, delight and speculation. All we know for sure is that nature created them and at the same time gave us the apparatus to perceive them and minds to appreciate their endless fascination. For the greatest profit and enjoyment they should be viewed as nature intended, with the eye of innocence, unclouded by theories and preconceptions, with the manifold vision, innate in all of us, that enriches and dignifies human life, rather than with the cultivated single vision of the dull and opinionated.

* * *

Perhaps the most famous spurious claim of a portentous pattern is the canals of Mars. First observed in 1877, they were seemingly confirmed by a succession of dedicated professional astronomers peering through large telescopes all over the world. A network of single and double straight lines was reported, crisscrossing the Martian surface and with such uncanny geometrical regularity that they could only be of intelligent origin. Evocative conclusions were drawn about a parched and dying planet populated by an older and wiser technical civilization dedicated to conservation of water resources.

Hundreds of canals were mapped and named. But, oddly, they avoided showing up on photographs. The human eye, it was suggested, could remember the brief instants^{ts} of perfect atmospheric transparency, while the ~~unintelligent~~^{undiscriminating} photographic plate ~~summed up~~^{averaged} the clear with the blurry moments. ~~Many~~^{Some} astronomers saw the canals, ~~but many~~^{few} did not, ~~and concluded~~^{many} ~~that~~^{and some} the whole business was some kind of perceptual delusion. ~~Perhaps certain observers were more skilled at seeing canals.~~^{But perhaps}

Much of the idea of Mars as an abode of life, as well as the prevalence of "Martians" in popular fiction, derives from the canals ~~and their expression in popular science and science~~ fiction. I myself grew up steeped in this literature, and when I found myself an experimenter on the Mariner 9 mission to Mars -- the first spacecraft to orbit the red planet -- naturally I was interested to see what the real circumstances were. With Mariner 9 and with Viking, we were able to map the planet pole-to-pole, detecting features hundreds of times smaller than the best that could be seen from Earth. I found, not altogether to my surprise, not a trace of canals. There were a few more or less linear features that had been made out through the telescope -- for example, a 5,000-kilometer-long rift valley that would have been hard to miss. ~~But~~^{an illusion,} the hundreds of "classical" ~~single and double~~ canals carrying water from the polar caps through the arid deserts to the thirsty equatorial cities simply did not exist. They were ~~a delusion~~^{an illusion,}, some malfunction of the human hand-eye-brain combination at the limit of resolution^{fu} when we peer

through an unsteady and turbulent atmosphere.

Even a succession of professional scientists -- including famous astronomers who had made other discoveries that are confirmed and now justly celebrated -- can make serious, even profound errors in pattern recognition. Especially where the implications of what we think we are seeing seem to be ^{profound} ~~of great importance~~, we may not exercise adequate self-discipline and self-criticism. The Martian canal myth constitutes an important cautionary tale.

For the canals, spacecraft missions provided the means of correcting our misapprehensions. But it is also true that some of the most haunting claims of unexpected patterns emerge from spacecraft exploration. In the early 1960s, I urged that we be attentive to the possibility of finding the artifacts of ancient civilizations -- either those indigenous to a given world, or those constructed by visitors from elsewhere. I didn't imagine that this would be easy or probable, and I certainly did not suggest that, on so important a matter, anything short of compelling evidence would be worth considering.

Beginning with John Glenn's evocative report of "fireflies" surrounding his space capsule, every time an astronaut reported seeing something not immediately understood, there were those who deduced "aliens." Prosaic explanations -- specks of paint flecking off the ship in the space environment, say -- were dismissed with contempt. The lure of the marvelous blunts our

critical faculties. (As if a man become a moon is not marvel enough.)

Around the time of the Apollo lunar landings, many non-experts -- owners of small telescopes, flying saucer zealots, writers for aerospace magazines -- pored over the returned photographs seeking anomalies that NASA scientists and astronauts had overlooked. Soon there were reports of gigantic Latin letters and Arabic numerals inscribed on the lunar surface, pyramids, highways, crosses, glowing UFOs. Bridges were reported on the Moon, radio antennas, the tracks of enormous crawling vehicles, and the devastation left by machines able to slice craters in two. Every one of these claims, though, turns out to be a natural lunar geological formation misjudged by amateur analysts, internal reflections in the optics of the astronauts' Hasselblad cameras, and the like. Some enthusiasts discerned the long shadows of ballistic missiles -- Soviet missiles it was ominously confided, aimed at America. The rockets, also described as "spires," turn out to be low hills casting long shadows when the Sun is near the lunar horizon. A little trigonometry dispels the mirage.

These experiences provide fair warning: For a complex terrain sculpted by unfamiliar processes, amateurs (and sometimes even professionals) examining photographs, especially near the limit of resolution, may get into trouble. Their hopes and fears, the excitement of possible discoveries of great import,

may overwhelm the usual skeptical and cautious approach of science.

If we examine available surface images of Venus, occasionally a peculiar landform swims into view -- as, for example, a ^{rough} portrait of Joseph Stalin discovered by American geologists analyzing Soviet orbital radar imagery. No one maintains, I gather, that unreconstructed Stalinists had doctored the magnetic tapes, or that the former Soviets were engaged in engineering activities of unprecedented and hitherto unrevealed scale on the surface of Venus -- where every spacecraft to land has been fried in a few hours. The odds are overwhelming that this feature, whatever it is, is due to geology. The same is true of what seems to be a portrait of the cartoon character Bugs Bunny on the Uranian moon Ariel. A Hubble Space Telescope image of Titan in the near-infrared shows clouds roughly configured to make a world-sized smiling face. Every planetary scientist has a favorite example. ^Q The astronomy of the Milky Way also is replete with imagined likenesses -- for example, the Horsehead, Eskimo, Owl, Homunculus, Tarantula, and North American Nebulae, all irregular clouds of gas and dust, illuminated by bright stars and of a scale that dwarfs our solar system. Summit N

Mars is much more clement than Venus, although the Viking landers provided no compelling evidence for life. Its terrain is extremely heterogeneous and diverse. With 100,000 or so close-up photographs available, it is not surprising that claims have been

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For The Demon-Haunted World:

N, II When astronomers mapped the distribution of galaxies out to a few hundred ^{million} light years, they found the galaxies outlining a kind of homunculus which has been called "the Stickman." ~~But~~ *The configuration* ~~this~~ is understood as something like enormous adjacent soap bubbles, the galaxies formed on the surface of the adjacent bubbles and almost no galaxies in the interiors. This makes it quite likely that the galaxies will mark out a pattern with bilateral symmetry something like the Stickman -- rather than the Universe on immense scales drawing an inept caricature of the beings who inhabit one obscure world.

There is something a little eerie about ^{these} ~~such~~ pyramids in the desert, so reminiscent of the Giza plateau in Egypt.

["The Man in the Moon and the Face on Mars" (M, 11/28/94)] 13

made over the years about something unusual on Mars. There is, for example, a cheerful "happy face" sitting inside a Martian impact crater 8 kilometers (5 miles) across, with a set of radial splash marks outside, making it look like the conventional representation of a smiling Sun. But no one claims that this has been engineered by an advanced (and excessively genial) Martian civilization, perhaps to attract our attention. We recognize that, with objects of all sizes falling out of the sky, with the surface rebounding, slumping, and reconfiguring itself after each impact, and with ancient water and mudflows and modern windborne sand sculpting the surface, a wide variety of landforms must be generated. If we scrutinize 100,000 pictures, it's not surprising that occasionally we'll come upon something like a face. With our brains programmed for this from infancy, it would be amazing if we couldn't find one here and there.

A few small mountains on Mars resemble pyramids. In the Elysium high plateau, there is a cluster of them -- the biggest a few kilometers across at the base -- all oriented in the same direction. ^{and I would love to examine them more closely.} Is it fair to deduce Martian pharaohs? Not really. ^{though,} ^{also} ^{in miniature} On a small scale, similar features are known on Earth, especially in Antarctica. Some of them would come up to your knees.

They're called dreikanters, from a German word meaning three sides. If we knew nothing else about them, would it be fair to conclude that they've been manufactured by ^{scale-model} ~~miniature~~ Egyptians living in the Antarctic wasteland? (The hypothesis loosely fits

the observations, but much else we know about the polar environment and the physiology of humans speaks against it.) They are, in fact, produced by wind erosion -- the splatter of fine particles picked up by strong winds blowing mainly in the same direction and, over the years, sculpting what once were irregular hummocks into nicely symmetrical pyramids. This is order generated out of chaos by natural processes -- something we see over and over again throughout the Universe. Each time it happens we're tempted to infer the direct intervention of a Maker.

On Mars, there is evidence of winds much fiercer than any ever experienced on Earth, ranging up to half the speed of sound. Planet-wide duststorms are common -- carrying fine grains of sand. A steady pitter-patter of particles moving much faster than in the fiercest gales of Earth should, over ages of geological time, work profound changes in rock faces and landforms. It would not be too surprising if a few features -- even very large ones -- were sculpted by aeolian processes into the pyramidal forms we see.

* * *

There is a place on Mars called Cydonia, where a great stone face a kilometer across stares unblinkingly up at the sky. It is an unfriendly face, but one that seems recognizably human. In

some representations, it could have been sculpted by Praxiteles. It lies in a landscape where many low hills have been molded into odd forms, perhaps by some mixture of ancient mudflows and subsequent wind erosion. From the number of impact craters, the surrounding terrain looks to be at least hundreds of millions of years old.

Intermittently, "The Face" has attracted attention, both in the United States and in the former Soviet Union. The headline in the November 20, 1984 Weekly World News, a supermarket tabloid not celebrated for its integrity, read:

SOVIET SCIENTIST'S AMAZING CLAIM: RUINED TEMPLES FOUND ON MARS. SPACE PROBE DISCOVERS REMAINS OF 50,000-YEAR-OLD CIVILIZATION.

The revelations are attributed to an anonymous Soviet source and breathlessly describe discoveries made by a nonexistent Soviet space vehicle.

But the story of "The Face" is almost entirely an American one. It was found by one of the Viking orbiters in 1976 [check: 1977?]. There was an unfortunate dismissal of the feature by a project official as a trick of light and shadow, which prompted a later accusation that NASA was covering up the discovery of the millennium. A few engineers, computer specialists, and others -- some of them contract employees of NASA -- worked on their own time to digitally enhance the image. Perhaps they hoped for stunning revelations. That's permissible in science, even encouraged -- as long as your standards of evidence are high.

Some of them were fairly cautious and deserve to be commended for advancing the subject. Others were less restrained, deducing not only that the Face was a genuine, monumental sculpture of a human being, but claiming to find a city nearby with temples and fortifications.** From spurious arguments, one writer announced that the monuments had a particular astronomical orientation -- not now, though, but half a million years ago -- from which it followed that these Cydonian wonders were erected in that remote epoch. But then how could the builders have been human? Half a million years ago, our ancestors were busy mastering stone tools and fire. They did not have spaceships.

The Martian Face is compared to "similar faces. . . constructed in civilizations on Earth. The faces are looking up at the sky because they're looking up to God." Or the Face was constructed by the survivors of an interplanetary war that left the surface of Mars (and the Moon) pockmarked and ravaged. What causes all those craters anyway? Is the Face a remnant of a long-extinct human civilization? Were the builders originally from Earth or Mars? Could the Face have been sculpted by interstellar visitors stopping briefly on Mars? Was it left for us to discover? Might they also have come to Earth and initiated

**The general idea is quite old, going back at least a century to the Martian canal myth of Percival Lowell. As one of many examples, P. E. Cleator, in his 1936 book Rockets Through Space: The Dawn of Interplanetary Travel, speculated: "On Mars, the crumbling remains of ancient civilizations may be found, mutely testifying to the one-time glory of a dying world."

life here? Or at least human life? Were they, whoever they were, gods? Much fervent speculation is evoked.

More recently, claims have been made for a connection between "monuments" on Mars and "crop circles" on Earth; of inexhaustible supplies of energy waiting to be extracted from ancient Martian machines; and of a massive NASA coverup to hide the truth from the American public. Such pronouncements go far beyond mere incautious speculation about enigmatic landforms.

When, in August 1993, the Mars Observer spacecraft failed within hailing distance of Mars, there were those who accused NASA of faking the mishap so it could study the Face in detail without having to release the images to the public. (If so, the charade is quite elaborate: All the experts on Martian geomorphology know nothing about it, and some of us have been working hard to design new missions to Mars less vulnerable to the malfunction that destroyed Mars Observer.) There was even a handful of pickets outside the gates of the Jet Propulsion Laboratory, worked up over this supposed abuse of power.

The tabloid Weekly World News for September 14, 1993 devoted its front page to the headline "New NASA Photo Proves Humans Lived on Mars!" A fake face, allegedly taken by Mars Observer in orbit about Mars (in fact, the spacecraft seems to have failed before achieving orbit), is said by a non-existent "leading space scientist" to prove that Martians colonized Earth 200,000 years ago. The information is being suppressed, he is made to say, to

prevent "world panic."

Put aside the improbability that such a revelation would actually lead to "world panic." For anyone who has witnessed a portentous scientific finding in the making -- the July 1994 impact of Comet Shoemaker-Levy 9 with Jupiter comes to mind -- it will be clear that scientists tend to be effervescent and uncontainable. They have an indomitable compulsion to share new data. I reject the notion that science is by its nature secretive. Its culture and ethos are, and for very good reason, collective, collaborative, and communicative.

If we restrict ourselves to what is actually known, and ignore the tabloid industry that manufactures epochal discoveries out of thin air, where are we? When we know only a little about the Face, it's hard to stare at it without being roused to tremulous conjecture. When we know a little more, the mystery quickly shallows.

Mars has a surface area of almost 150 million square kilometers. The area covered by the Martian "sphinx" is about one square kilometer. Is it so astonishing that one postage-stamp-sized patch in 150 million should look a little funny -- especially given our penchant, since infancy, for finding faces? When we examine the neighboring jumble of hillocks, mesas, and other complex surface forms, we recognize that the feature is akin to many that do not at all resemble a human face. Why this resemblance? Would the ancient Martian engineers rework only

this mesa (well, maybe a few others) and leave all others unimproved by monumental sculpture? Or shall we conclude that other blocky mesas are also sculpted into the form of faces, but weirder faces unfamiliar to us on Earth?

If we study the original image more carefully, we find that a strategically placed "nostril" -- one that adds much to the impression of a face -- is in fact a black dot corresponding to lost data in the radio transmission from Mars to Earth. The best picture of the Face shows one side lit by the Sun, the other in deep shadow. Using the original digital data, we can severely enhance the contrast in the shadows. When we do, we find something rather unfacelike there. The Face is at best half a face. Despite our shortness of breath and the beating of our hearts, this Martian sphinx looks natural -- not artificial, not a dead ringer for a human face. It was probably sculpted by slow geological process over millions of years.

But I might be wrong. It's hard to be sure about a world we've seen so little of in extreme close-up. These features merit closer attention with higher resolution. Much more detailed photos of the "face" would surely settle issues of symmetry and help resolve the debate between geology and monumental sculpture. Small impact craters found on or near the Face can fairly definitively settle the question of its age. In the case (most unlikely in my view) that the nearby structures were really once a city, that fact should also be obvious on

closer examination. Are there broken streets? Crenelations in the "fort"? Ziggurats, towers, columned temples, monumental statuary, immense frescoes? Or just rocks?

Even if these claims are extremely improbable -- as I think they are -- they are worth examining. Unlike the UFO phenomenon, we have here the opportunity for a definitive experiment. This kind of hypothesis is falsifiable, a property that brings it into the scientific arena. I hope that forthcoming American and Russian missions to Mars, especially orbiters with high-resolution television cameras, will make a special effort -- among hundreds of other scientific questions -- to look much more closely at what some people call the pyramids, the Face, and the city.

* * *

Even if it becomes plain to everyone that these Martian features are geological and not artificial, monumental faces in space (and allied wonders) will not, I fear, go away. Already there are supermarket tabloids reporting nearly identical faces seen from Venus to Neptune (floating in the clouds?). The "findings" are typically attributed to fictitious Russian spacecraft and imaginary space scientists -- which of course makes it marginally harder for a skeptic to check the story out.

One of the Mars face enthusiasts now announces

Breakthru News of the Century

Censored by NASA
for fear of Religious upheavals and breakdowns.
The Discovery of ancient
ALIEN RUINS ON THE MOON.

A "giant city, size of Los Angeles basin, covered by immense glass dome, abandoned millions of years ago, and shattered by meteors with gigantic tower 5 miles tall, with giant one mile square cube on top" is breathlessly "CONFIRMED" -- on the well-studied Moon. The evidence? Photos taken by NASA robotic and Apollo missions whose significance was suppressed by the government and overlooked by all those lunar scientists in many countries who don't work for "the government." What are the lunar coordinates of these startling artifacts? Do they show up in, say, Lunar Orbiter, Apollo, and Clementine data when cross-checked? We are not told.

The August 18, 1992 issue of Weekly World News reports the discovery by "a secret NASA satellite" of "thousands maybe even millions of voices" emanating from the black hole at the center of the galaxy M51, all singing "'Glory, glory, glory to the Lord on high' over and over again." In English. There is even a tabloid report, fully although murkily illustrated, of a space probe that photographed God, or at least his eyes and the bridge of his nose, up there in the Orion Nebula.

The July 20, 1993 WWN sports a banner headline, "Clinton Meets With JFK!" along with a faked photo of a plausibly aged, slumped-over John Kennedy, having secretly survived the assassination attempt, in a wheelchair at Camp David. Many pages

inside the tabloid, we are informed about another item of possible interest. In "Doomsday Asteroids," an alleged top-secret document quotes alleged "top" scientists about an alleged asteroid ("M-167") that will allegedly hit the Earth on November 11, 1993 and "could mean the end of life on Earth." President Clinton is described as being kept "constantly informed of the asteroid's position and speed." Perhaps it was one of the items he discussed in his meeting with President Kennedy. Somehow, the fact that the Earth escaped this catastrophe did not merit even a retrospective paragraph after November 11, 1993 uneventfully passed. At least the headline writer's judgment not to burden the front page with news of the end of the world was vindicated.

Some see this as just a kind of fun. However, we live in a time when a real long-term statistical threat of an impact of an asteroid with the Earth has been identified. (This real science is of course the inspiration, if that's the word, of the WWN story.) Government agencies are studying what to do about it. Stories like this suffuse the subject with apocalyptic exaggeration and whimsy, make it difficult for the public to distinguish real perils from tabloid fiction, and conceivably can impede our ability to take precautionary steps to mitigate the danger.

The tabloids are often sued -- sometimes by actors and actresses who stoutly deny they have performed loathsome deeds -- and large sums of money occasionally change hands. The tabloids

must consider such suits as just one of the costs of doing a very profitable business. In their defense they often say that they are at the mercy of their writers and have no institutional responsibility to check out the truth of what they publish. Sal Ivone, the managing editor of Weekly World News, discussing the stories he publishes, says "For all I know, they could be the product of active imaginations. But because we're a tabloid, we don't have to question ourselves out of a story." But writers who have defected from the tabloids describe "creative" sessions in which writers and editors dream up stories and headlines out of whole cloth, the more outrageous the better.

Out of their immense readership, are there not many who take the stories at face value, who believe they "couldn't" print it if it wasn't so? Some tabloid readers I talk to insist they read them only for entertainment, that they are not in the least taken in, that the tabloids are understood by publisher and reader alike to be fantasies that explore the absurd. They exist outside any universe burdened by rules of evidence.

In the 1990s the tabloid universe of discourse is expanding, voraciously gobbling up other media. Newspapers, magazines, or television programs that suffer under prissy restraints imposed by what is actually known are outsold by media outlets with less scrupulous standards. We can see this in the new generation of acknowledged tabloid television, and increasingly in what passes for news and information programs.

Such reports persist and proliferate because they sell. And they sell, I think, because there are so many of us who want so badly to be jolted out of our humdrum lives, to rekindle that sense of wonder we remember from childhood, and also to be able, really and truly, to believe -- in Someone older, smarter, and wiser who is looking out for us. Faith is clearly not enough for many people, including purchasers of tabloid newspapers. They crave hard evidence, scientific proof. They long for the scientific seal of approval, but are unwilling to put up with the rigorous standards of evidence that impart credibility to that seal. What a relief it would be, doubt reliably abolished! Then, the irksome burden of looking after ourselves would be lifted. We're worried -- and for good reason -- about what it means for the human future if we have only ourselves to rely upon.

These are the modern miracles -- shamelessly vouched for by those who make them up from scratch, bypassing any formal skeptical scrutiny, and available at low cost in every supermarket and grocery store in the land. One of the pretences of the tabloids is to make science, the very instrument of our disbelief, confirm our ancient faiths.

By and large, scientists' minds are open when exploring new worlds. If we knew beforehand what we'd find, it would be unnecessary to go. In future missions to Mars or to the other fascinating worlds in our neck of the cosmic woods, surprises --

even some of mythic proportions -- are possible, maybe even likely. But we humans have a talent for deceiving ourselves. Skepticism must be a component of the explorer's toolkit, or we will lose our way. There are wonders enough out there without us inventing any.

[M, 11/28/94]

Chapter 4

ALIENS

"Truly, that which makes me believe there is no inhabitant on this sphere, is that it seems to me that no sensible being would be willing to live here."

"Well, then!" said Micromegas, "perhaps the beings that inhabit it do not possess good sense."

-- One alien to another in Voltaire's "Micromegas. A Philosophical History" (1752)

It's still dark out. You're lying in bed, fully awake -- but you discover you're utterly paralyzed. You sense someone in the room. You try to cry out. You cannot. Several small gray beings, less than four feet tall, are standing at the foot of the bed. Their heads are pear-shaped, bald, and large for their bodies. Their eyes are enormous, their faces expressionless and identical. They wear tunics and boots. You hope this is only a dream. But as nearly as you can tell it's really happening. They lift you up and, eerily, they and you slip through the wall of your bedroom. You float out into the air. You rise high toward a metallic saucer-shaped spacecraft. Once inside, you are escorted into a medical examining room. A larger but similar being -- evidently some kind of physician -- takes over. What follows is even more terrifying.

Your body is probed with instruments and machines, especially your sexual parts. If you're a man, they may take sperm samples; if you're a woman, they may remove ova or fetuses, or implant semen. They may force you to have sex. Afterwards

you may be ushered into a different room where hybrid babies or fetuses, partly human and partly like these creatures, stare back at you. You may be given an admonition about human misbehavior, especially in despoiling the environment or in allowing the AIDS pandemic; tableaux of future devastation are offered. Finally, these cheerless gray emissaries escort you out of the spacecraft and ooze you back through the walls into your bed. By the time you're able to move and talk. . . they're gone.

You may not remember the incident right away. Instead you might simply find some period of time unaccountably missing, and puzzle over it. Because all this seems so weird, you're a little concerned about your sanity. Naturally you're reluctant to talk about it. At the same time the experience is so disturbing that it's hard to keep it bottled up. It all pours out when you hear of similar accounts, or when you're under hypnosis with a sympathetic therapist, or even when you see a picture of an "alien" in one of the many popular magazines, books, and TV "specials" on UFOs. Some people say they can recall such experiences from early childhood. Their own children, they think, are now being abducted by aliens. It runs in families.

As revealed by repeated polls over the years, most Americans believe that we're being visited by extraterrestrial beings in UFOs. In a 1992 Roper poll of nearly 6,000 American adults -- especially commissioned by those who accept the alien abduction story at face value -- 18 percent reported sometimes waking up

paralyzed, aware of one or more strange beings in the room. About 13 percent report odd episodes of missing time, and 10 percent claim to have flown through the air without mechanical assistance. From nothing more than these results, the poll's sponsors conclude that two percent of all Americans have been abducted, many repeatedly, by beings from other worlds. The question of whether respondents have been abducted by aliens was never actually put. If we believed the conclusion drawn by the pollsters, and if aliens are not partial to Americans, then the number for the whole planet would be more than a hundred million people. This means an abduction every few seconds over the past few decades. It's surprising more of the neighbors haven't noticed.

What's going on here? When you talk with self-described abductees, most seem very sincere, although caught in the grip of powerful emotions. Psychiatrists who've examined them say they find no more evidence of psychopathology in them than in the rest of us. Why should anyone claim to have been abducted by alien creatures if it never happened? Could all these people be mistaken, or lying, or hallucinating the same (or a similar) story? Or is it arrogant and contemptuous even to question the good sense of so many?

But could there really be a massive alien invasion; repugnant medical procedures performed on millions of innocent men, women, and children; humans apparently used as breeding

stock over many decades -- and all this not generally known and dealt with by responsible media, physicians, scientists, and the governments sworn to protect the lives and well-being of their citizens? Or, as many have suggested, is there a massive government conspiracy to keep the citizens from the truth?

Why should beings so advanced in physics and engineering -- crossing vast interstellar distances, walking like ghosts through walls -- be so backward when it comes to biology? Why, if the aliens are trying to do their business in secret, wouldn't they perfectly expunge all memories of the abductions? Too hard for them to do? Why are the examining instruments macroscopic and so reminiscent of what can be found at the neighborhood medical clinic? Why go to all the trouble of repeated sexual encounters between aliens and humans? Why not steal a few egg and sperm cells, read the full genetic code, and then manufacture as many copies with whatever genetic variations happen to suit your fancy? Even we humans, who as yet cannot quickly cross interstellar space or slither through walls, are able to clone cells. The preoccupation with reproduction in these accounts raises a warning flag -- especially considering the uneasy balance between sexual impulse and societal repression that has always characterized the human condition, and the fact that we live in a time fraught with numerous ghastly accounts, both true and false, of childhood sexual abuse.

Contrary to many media reports,* the Roper pollsters never asked whether their subjects had been abducted by aliens; they deduced it: Those who've ever awakened with strange presences around them, who've ever unaccountably seemed to fly through the air, and so on, have therefore been abducted. The pollsters didn't even check to see if sensing presences, flying, etc. were part of the same or separate incidents. Their conclusion -- that millions of Americans have been so abducted -- is spurious, based on careless experimental design.

Still, at least hundreds of people, perhaps thousands, believing they have been abducted, have sought out sympathetic therapists or joined abductee support groups. Others may have similar complaints but, fearing ridicule or the stigma of mental illness, have refrained from speaking up or getting help.

Abductees are also said to be reluctant to talk for fear of hostility and rejection by hardline skeptics. Their diffidence supposedly extends even to audiences that already believe in alien abductions. But maybe there's another reason: Might the subjects themselves be unsure -- at least at first, at least before many retellings of their story -- whether it was an external event they are remembering or a state of mind?

* * *

*For example, the September 4, 1994 Publisher's Weekly: "According to a Gallup [sic] poll, more than three million Americans believe they have been abducted by aliens."

The phrase "flying saucer" was coined when I was in high school. The newspapers were full of stories about ships from elsewhere in the skies of Earth. It seemed pretty believable to me. There were lots of other stars, at least some of which probably had planetary systems like ours. Many stars were as old or older than the Sun, so there was plenty of time for intelligent life to evolve. Caltech's Jet Propulsion Laboratory had just flown a two-stage rocket high above the Earth. Clearly we were on our way to the Moon and the planets. Why shouldn't other, older, wiser beings be able to travel from their star to ours? Why not?

This was only a few years after the bombing of Hiroshima and Nagasaki. Maybe the UFO occupants were worried about us, and sought to help us. Or maybe they wanted to make sure that we and our nuclear weapons didn't come and bother them. Many people seemed to see flying saucers -- sober pillars of the community, police officers, commercial airplane pilots, military personnel. And apart from some harumphs and giggles, I couldn't find any counterarguments. How could all these eyewitnesses be mistaken? What's more, the saucers had been picked up on radar, and pictures had been taken of them. You could see the photos in newspapers and glossy magazines. There were even reports about crashed flying saucers and little alien bodies with perfect teeth stiffly languishing in Air Force freezers in the Southwest.

The prevailing climate was summarized in Life magazine a few years later, in these words: "These objects cannot be explained by present science as natural phenomena -- but solely as artificial devices, created and operated by a high intelligence." Nothing "known or projected on Earth could account for the performance of these devices."

And yet not a single adult I knew was preoccupied with UFOs. I couldn't figure out why not. Instead they were worried about Communist China, nuclear weapons, McCarthyism, and the mortgage. I wondered if they had their priorities straight.

In college, in the early 1950s, I began to learn a little about how science works, the secrets of its great success, how rigorous the standards of evidence must be if we are really to know something is true, how many false starts and dead ends have plagued human thinking, how our biases can color our interpretation of the evidence, and how often belief systems widely held and supported by the political, religious, and academic hierarchies turn out to be not just slightly in error, but grotesquely wrong.

To my surprise, I found that human history had been plagued by misapprehensions and conscious hoaxes -- charlatans plying their trade of conning the marks. But I also discovered that in every generation there was a community devoted to finding out what's true, let the consequences fall where they may -- skeptical detectives who spent their lives unmasking self-

deception and intellectual fraud.

I came upon a book called Extraordinary Popular Delusions and the Madness of Crowds, written by Charles Mackay in 1841, and still in print. In it could be found the histories of boom-and-bust economic crazes, including the Mississippi and South Sea "Bubbles" and the extravagant run on Dutch tulips, scams that bamboozled the wealthy and titled of many nations; a legion of alchemists, including the poignant tale of Mr. Kelly and Dr. Dee (and Dee's 8-year-old son Arthur, impressed by his desperate father into communicating with the spirit world by peering into a crystal); dolorous accounts of unfulfilled prophecy, divination, and fortune-telling; the persecution of witches; haunted houses; "popular admiration of great thieves"; and much else. Entertainingly portrayed was the Count of St. Germain, who dined out on the cheerful pretension that he was centuries old if not actually immortal. (When, at dinner, incredulity was expressed at his recounting of his conversations with Richard the Lion-Hearted, he turned to his man-servant for confirmation; "You forget, sir," was the reply, "I have been only five hundred years in your service"; "Ah, true," said St. Germain, "it was a little before your time.")

A riveting chapter on the Crusades began

Every age has its peculiar folly; some scheme, project, or phantasy into which it plunges, spurred on either by the love of gain, the necessity of excitement, or the mere force of imitation. Failing in these, it has some madness, to which it is goaded by political or religious causes, or both combined.

The edition I first read was adorned by a quote from the financier and adviser of Presidents, Bernard M. Baruch, attesting that reading Mackay had saved him millions.

There had been a long history of spurious claims that magnetism could cure disease. Paracelsus, for example, used a magnet to suck diseases out of the human body and dispose of them into the Earth. But the key figure was Franz Mesmer. I had vaguely understood the word "mesmerize" to mean something like hypnotize. But my first real knowledge of Mesmer came from Mackay. The Viennese physician had thought that the positions of the planets influenced human health, and was caught up in the wonders of electricity and magnetism. He catered to the declining French nobility on the eve of the Revolution. They crowded into a darkened room. Dressed in a gold-flowered silk robe and waving an ivory wand, Mesmer seated his marks around a vat of dilute sulfuric acid. They grasped iron bars protruding into the solution or held each other's hands. Aristocrats were cured left and right.

Mesmer became a sensation. He called it "animal magnetism." For the more conventional medical practitioner, this was bad for business, so French physicians pressured King Louis XVI to crack down. Mesmer, they said, was a menace to public health. A commission was appointed by the French Academy of Sciences that included the pioneering chemist, Antoine Lavoisier, and the American diplomat and expert on electricity, Benjamin Franklin.

They performed the obvious control experiment: When the magnetizing effects were performed without the patient's knowledge, no cures were effected. The cures, if any, the commission concluded, were all in the mind of the beholder. Mesmer and his followers were undeterred. One of them later urged the following attitude of mind for the best results:

Forget for a while all of your knowledge of physics. . .
Remove from your mind all objections that may occur. . .
Never reason for six weeks. . . Be very credulous; be very persevering; reject all past experience, and do not listen to reason.

Oh, yes, one final piece of advice: "Never magnetize before inquisitive persons."

Another eye-opener was Martin Gardner's Fads and Fallacies in the Name of Science. Here was Andrew Crosse creating microscopic insects electrically from salts; Hans Hörbiger under Nazi aegis announcing that the Milky Way was made not of stars, but of snowballs; Charles Piazzi Smyth discovering in the dimensions of the Great Pyramid of Gizeh a world chronology from the Creation to the Second Coming; Wilhelm Reich uncovering the key to the structure of galaxies in the energy of the human orgasm; L. Ron Hubbard writing a manuscript able to drive its readers insane (was it ever proofed? I wondered); the Bridey Murphy case, which misled millions into concluding that at last there was serious evidence of reincarnation; Joseph Rhine's "demonstrations" of ESP; appendicitis cured by cold water enemas, bacterial diseases by brass cylinders, and gonorrhea by green

light -- and amid all these accounts of self-deception and charlatanry, to my surprise a chapter on UFOs.

Of course, merely by writing books cataloging spurious beliefs, Mackay and Gardner came across, at least a little, as grumpy and superior. Was there nothing they accepted? Still, it was stunning how many passionately argued and defended claims to knowledge had amounted to nothing. It slowly dawned on me that, human fallibility being what it is, there might be other explanations for flying saucers.

I ^{had been} ~~was~~ interested in the possibility of extraterrestrial life from childhood, from long before I ever heard of flying saucers. I've remained fascinated long after my early enthusiasm for UFOs waned -- as I understood more about that remorseless taskmaster called the scientific method: Everything hinges on the matter of evidence. On so important a question, the evidence must be airtight. The more we want it to be true, the more careful we have to be. No witness's say-so is good enough. People make mistakes. People play practical jokes. People stretch the truth for money or attention or fame. People sometimes even see things that aren't there.

Essentially all the UFO cases were anecdotes, something asserted. UFOs were described variously as rapidly moving or hovering; disc-shaped, cigar-shaped, or ball-shaped; moving silently or noisily; with a fiery exhaust, or with no exhaust at all; accompanied by flashing lights, or uniformly glowing with a

silvery cast, or self-luminous. The diversity of the observations hinted that they had no common origin, and that the use of such terms as UFOs or "flying saucers" served only to confuse the issue by grouping generically a set of unrelated phenomena.

There was something odd about the very invention of the phrase "flying saucer." As I write this chapter, I have before me a transcript of an April 7, 1950 interview between Edward R. Murrow, the celebrated CBS newsman, and Kenneth Arnold, a civilian pilot who saw something odd near Mount Rainier in the state of Washington on June 24, 1947 and who in a way coined the phrase. Arnold claims that the newspapers

did not quote me properly. . . . When I told the press they misquoted me, and in the excitement of it all, one newspaper and another one got it so ensnarled up that nobody knew just exactly what they were talking about. . . . These objects more or less fluttered like they were, oh, I'd say, boats on very rough water. . . . And when I described how they flew, I said that they flew like they take a saucer and throw it across the water. Most of the newspapers misunderstood and misquoted that, too. They said that I said that they were saucer-like; I said that they flew in a saucer-like fashion.

Arnold thought he saw a train of nine objects, one of which produced a "terrific blue flash." He concluded they were a new kind of winged aircraft. Murrow summed up: "That was an historic misquote. While Mr. Arnold's original explanation has been forgotten, the term 'flying saucer' has become a household word." Kenneth Arnold's flying saucers looked and behaved quite differently from what in only a few years would be rigidly particularized in the public understanding of the term:

[12-11-94.at1]

Quantum Q, Ch 4, p. 13

~~For The Demon-Haunted World:~~

~~These instances of anomalous radio propagation have~~
~~traditionally~~ ^{they've also} been called radar "angels" -- after something that
seems to be there but isn't.

something like a very large and highly maneuverable frisbee.

Most people honestly reported what they saw, but what they saw were natural, if unfamiliar, phenomena. Some UFO sightings turned out to be unconventional aircraft, conventional aircraft with unusual lighting patterns, high-altitude balloons, luminescent insects, planets seen under unusual atmospheric conditions, optical mirages and looming, lenticular clouds, ball lightning, sundogs, meteors including green fireballs, and satellites, nosecones, and rocket boosters spectacularly reentering the atmosphere.** Just conceivably, a few might be small comets dissipating in the upper air. At least some radar reports were due to "anomalous propagation" -- radio waves travelling curved paths due to atmospheric inversions. *Smart Q* You could have simultaneous visual and radar sightings without there being any "there" there.

When we notice something strange in the sky, some of us become excitable and uncritical, bad witnesses. There were UFO reports due to psychological aberrations, or to hoaxes. There was the suspicion that the field attracted rogues and charlatans. Many UFO photos turned out to be fakes -- small models hanging by thin threads, often photographed in a double exposure. A UFO seen by thousands of people at a football game turned out to be a

**There are so many artificial satellites up there that they're always making garish displays somewhere in the world. Two or three decay every day in the Earth's atmosphere, the flaming debris often visible to the naked eye.

Frank Scully, columnist for Variety, had been told a story by an oil-man friend which played a dramatic role in Scully's best-selling book Behind the Flying Saucers. Sixteen dead aliens, ^{from Venus, each 3 feet high,} were found in one of three crashed saucers. They had booklets with pictographs ^{that had been re-} covered. ^{They came from Venus.} The ¹⁴ hoaxers were Silas Newton, who said he used ^{micro} radio waves to prospect for gold and oil, and a mysterious "Dr. Gee" who turned out to be a Mr. Go Baner college fraternity prank -- a piece of cardboard, some candles,

and a thin plastic bag that dry cleaning comes in cobbled together to make a rudimentary hot air balloon. The original crashed saucer story (with the little alien men and their perfect teeth) turned out to be a straight-out hoax, ~~reporters being taken in by experienced confidence men [details to come].~~

On October 4, 1957, Sputnik 1, the first Earth-orbiting artificial satellite, was launched. Of 1,178 recorded UFO sightings in America that year, 701, or 60 percent -- rather than the 25 percent you'd expect -- occurred between October and December. The clear implication is that Sputnik and its attendant publicity somehow generated UFO reports. Perhaps people were looking at the night sky more, and saw more natural phenomena they didn't understand. Or, could it be they looked up more and saw more of the alien spacecraft that are there all the time?

The idea of flying saucers had dubious antecedents, tracing back to a conscious hoax entitled I Remember Lemuria! published in the March 1945 number of the pulp fiction periodical Amazing Stories. It was exactly the sort of stuff I devoured as a child. Lost continents were settled by space aliens 150,000 years ago, I was informed, leading to the creation of a race of demonic underground beings responsible for human tribulations and evil. The editor of the magazine, Ray Palmer -- who was, like the subterranean beings he warned about, roughly four feet high --

Their exploits -- chronicled by the historian Curtis Peobles -- should have made UFO enthusiasts cautious forever about crashed saucer stories from the American Southwest around 1950. No such luck.

Newton produced a gear from alien machinery and flashed close-up photos of UFOs. But he did not allow close inspection. When a ^{prepared} skeptic through slight of hand switched gears and sent the alien gear away for analysis, it turned out to be ^{made of} kitchen-pot aluminum. The crashed saucer scan

["Aliens" (M, 11/28/94)] was a small ^{interlude} ~~part of~~ a quarter-century of Newton and GEBauer selling worthless oil leases and prospecting machines. In 1953 they were ~~found~~ ^{arrested} by the FBI, and the following year found guilty of promoting the notion, well before Arnold's sighting, that the ^{conducting a confidence game.}

Earth is being visited by disk-shaped alien spacecraft and that the government is covering up its knowledge and complicity.

Merely from the newsstand covers of such magazines, millions of Americans were exposed to the idea of flying saucers well before the term was coined.

All in all, the alleged evidence seemed thin -- most often devolving into credulity, hoax, hallucination, misunderstanding of the natural world, hopes and fears disguised as evidence, and a craving for attention, fame, and fortune. Too bad, I remember thinking.

Since then, I've been lucky enough to be involved in sending spacecraft to other planets to look for life, and in listening for possible radio signals from alien civilizations, if any, on planets of distant stars. We've had a few tantalizing moments. But if the suspected signal isn't available for every grumpy skeptic to pick over, we cannot call it evidence of extraterrestrial life -- no matter how appealing we find the notion. We'll just have to wait until, if such a time ever comes, better data are available. We've not yet found compelling evidence for life beyond the Earth. We're only at the very beginning of the search, though. New and better information might emerge, for all we know, tomorrow.

I don't think anyone could be more interested than I am in whether we're being visited. It would save me so much time and

effort to be able to study extraterrestrial life directly and nearby, rather than at best indirectly and at a great distance. Even if the aliens are short, dour, and sexually obsessed -- if they're here, I want to know about them.

* * *

How modest our expectations are about "aliens," and how shoddy the standards of evidence that many of us are willing to accept, can be found in the saga of the crop circles. Originating in Great Britain and spreading throughout the world was a strange phenomenon:

Farmers or passers-by would discover circles (and, in later years, much more complex pictograms) impressed upon fields of wheat, oats, barley, and oilseed rape. Beginning with simple circles in the middle 1970s, the phenomenon progressed year by year, until by the late 1980s and early 1990s the countryside, especially in southern England, was graced by immense geometrical figures, some the size of football fields, imprinted on cereal grain before the harvest -- circles tangent to circles, or connected by axes, parallel lines drooping off, "insectoids." Some of the patterns showed a central circle surrounded by four symmetrically-placed smaller circles -- clearly, it was concluded, caused by a flying saucer and its four landing pods.

A hoax? Impossible, almost everyone said. There were hundreds of cases. It was done sometimes in only an hour or two in the dead of night, and on such a large scale. No footprints of pranksters leading towards or away from the pictograms could be found. And besides, what possible motive could there be for a hoax?

Many less conventional conjectures were offered. People with some scientific training examined sites, spun arguments, instituted whole journals devoted to the subject. Were the figures caused by strange whirlwinds called "columnar vortices," or even stranger ones called "ring vortices"? What about ball lightning? Japanese investigators tried to simulate, in the laboratory and on a small scale, the plasma physics they thought was working its way on far-off Wiltshire.

But especially as the crop figures became more complex, meteorological or electrical explanations became more strained. Plainly, it was due to UFOs, the aliens communicating to us in a geometrical language. Or perhaps it was the devil, or the long-suffering Earth complaining about the depredations visited upon it by the hand of Man. New Age tourists engulfed the landscape. All-night vigils were undertaken by enthusiasts equipped with audio recorders and infrared vision scopes. Print and electronic media from all over the world tracked the intrepid cerealogists. Best-selling books on extraterrestrial crop distorters were purchased by a breathless and admiring public. True, no

geometrical figure was actually filmed in the course of being generated. But dowzers authenticated their alien origin, and channelers made contact with the entities responsible. "Orgone energy" was detected within the circles.

Questions were asked in Parliament. The royal family called in for special consultation Lord Solly Zuckerman, former principal scientific adviser to the Ministry of Defence. Ghosts were said to be involved; also, the Knights Templar of Malta and other secret societies. Satanists were implicated. The Defence Ministry was covering the matter up. A few inept and inelegant circles were judged attempts by the military to throw the public off the track. The tabloid press had a field day. The Daily Mirror hired a farmer and his son to make five circles in hope of tempting a rival tabloid, the Daily Express, into reporting the story. The Express was in this case not taken in.

"Cerealogical" organizations grew and splintered. Competing groups sent each other intimidating doggerel. Accusations were made of incompetence or worse. The number of crop "circles" rose into the thousands. The phenomenon spread to the United States, Canada, Bulgaria, Hungary, Japan, the Netherlands. The pictograms -- especially the more complex of them -- began to be quoted increasingly in arguments for alien visitation. One scientist of my acquaintance ^{wrote to} ~~told~~ me that extremely sophisticated mathematics was hidden in these figures; they could only be the result of a superior intelligence. In fact, one matter on which

almost all of the contending cerealists agreed is that the later crop figures were much too complex and elegant to be due to mere human intervention, much less to some ragged and irresponsible hoaxers. Extraterrestrial intelligence was apparent at a glance. . .

In 1991, Doug Bower and Dave Chorley, two blokes from Southampton, announced they had been making crop figures for 15 years. They dreamed it up over stout one evening in their regular pub, The Percy Hobbes. They had been amused by UFO reports and thought it might be fun to spoof the UFO gullibles. At first they flattened the wheat with the heavy steel bar that Bower used as a security device on the back door of his picture framing shop. Later on they used planks and ropes. Their first efforts took only a few minutes. But, being inveterate pranksters as well as serious artists, the challenge began to grow on them. Gradually, they designed and executed more and more demanding figures.

At first no one seemed to notice. There were no media reports. Their artforms were neglected by the tribe of UFOlogists. They were on the verge of abandoning crop circles to move on to some other, more ^{emotionally} rewarding hoax.

Suddenly crop circles caught on. UFOlogists fell for it hook, line, and sinker. Bower and Chorley were delighted -- especially when scientists and others began to announce their considered judgment that no merely human intelligence could be

responsible.

Carefully they planned each nocturnal excursion -- sometimes following meticulous diagrams ^{they had prepared} ~~done~~ in watercolors. They closely tracked their interpreters. When a local meteorologist deduced a kind of whirlwind because all of the crops were deflected downward in a clockwise circle, they confounded him by making a new figure with an exterior ring flattened counterclockwise.

Soon other crop figures appeared in southern England and elsewhere. Copycat hoaxsters had appeared. Bower and Chorley carved out a responsive message in wheat: "WEARENOTALONE." Even this some took to be a genuine extraterrestrial message (although it would have been much better had it read "YOUARENOTALONE").

Doug and Dave

~~They~~ began signing their artworks with two Ds; even this was attributed to a mysterious extraterrestrial purpose. Bower's nocturnal disappearances aroused the suspicions of his wife Ilene. Only with great difficulty -- Ilene accompanying Dave and Doug one night, and then joining the credulous in admiring their handiwork next day -- was she convinced that his absences were, in this sense, innocent.

Eventually Bower and Chorley tired of the increasingly elaborate prank. While in excellent physical condition, they were both in their sixties now and a little old for nocturnal commando operations in the fields of unknown and often unsympathetic farmers. They may have been annoyed at the fame and fortune accrued by those who merely photographed their art

and announced aliens to be the artists. And they became worried that if they delayed much longer, no statement of theirs would be believed.

So they confessed. They demonstrated before reporters how they made even the most elaborate insectoid patterns. You might think that never again would it be argued that a sustained hoax over many years is impossible, and never again would we hear that no one could possibly be motivated to deceive the ~~credulous~~ ^{gullible} into thinking that aliens exist. But the media paid brief attention. Cerealogists urged them to go easy; after all, they were depriving many of the pleasure of imagining wondrous happenings.

Since then, other crop circle hoaxers have kept at it, but in a more desultory and less inspired manner. As always, the confession of the hoax is greatly overshadowed by the sustained initial excitement. Many have heard of the pictograms in cereal grains and their alleged UFO connection, but draw a blank when the names of Bower and Chorley are raised ^{-- or the very idea that the whole business may be a hoax --}. An informative exposé by the journalist Jim Schnabel (Round in Circles) is in print. Schnabel joined the cerealogists early, gives a first-hand account of the whole story, and in the end made a few successful pictograms himself. (He prefers a garden roller to a wooden plank, and found that simply stomping grain with one's feet does an acceptable job.) But Schnabel's work, which one reviewer called "the funniest book I've read in ages," had only modest success. Demons sell; hoaxers are boring and in bad taste.

* * *

The tenets of skepticism do not require an advanced degree, as most successful used car buyers demonstrate. The whole idea of a democratic application of skepticism is that everybody can have the essential tools to be an effective and constructive skeptic. All science asks, when we're confronted with a claim to knowledge, is to employ the same levels of skepticism we use in buying a used car or in judging the quality of analgesics or beer from their television commercials.

But the tools of skepticism are not generally made available to the citizens of our society. They're hardly taught at all in the schools, although skepticism repeatedly sprouts spontaneously out of the disappointments of everyday life. Our politics, economics, advertising, and religions (New Age and Old) are awash in credulity. Those who have something to sell, those who wish to influence public opinion, those in power, a skeptic might suggest, have a vested interest in discouraging skepticism.

[M, 11/28/94]

Chapter 5

SPOOFING AND SECRECY

Trust a witness in all matters in which neither his self-interest, his passions, his prejudices, nor the love of the marvelous is strongly concerned. When they are involved, require corroborative evidence in exact proportion to the contravention of probability by the thing testified.

-- Thomas Henry Huxley (1825-1895)

When the mother of celebrity abductee Travis Walton was informed that a UFO had zapped her son with a bolt of lightning and then carried him off into space, she replied incuriously, "Well, that's the way these things happen." *Is it?* ~~How do these things~~
~~really happen?~~

To agree that UFOs are in our skies is not committing to very much: "UFO" is an abbreviation for "Unidentified Flying Object." It is a more inclusive term than "Flying Saucer." That there are things seen which the ordinary observer, or even an occasional expert, does not understand is inevitable. But why, if we see something we don't recognize, should we conclude it's a ship from the stars? A wide variety of more prosaic possibilities present themselves.

After misapprehended natural events and hoaxes and psychological aberrations are removed from the data set, is there any residue of reliably reported but extremely bizarre cases, especially cases supported by physical evidence? Is there a "signal" hiding in all that noise? In my view, no signal has

been detected. There are reliably reported cases that are unexotic, and exotic cases that are unreliable. There are no cases -- despite well over a million UFO reports since 1947 -- in which something so strange that it could only be an extraterrestrial spacecraft is reported so reliably that misapprehension, hoax, or hallucination can be reliably excluded. There's still a part of me that says, "Too bad."

We're regularly bombarded with extravagant UFO claims vended in bite-sized packages, but only rarely do we get to hear about their comeuppance. This isn't hard to understand: Which sells more newspapers and books, which garners higher ratings, which is more fun to believe, which is more resonant with the torments of our time -- *crashed alien ships, or experienced con men preying on the gullible;* ~~that alien beings~~ *extra-terrestrials* of immense powers ~~are~~ *ing* toying with the human species, or ~~that~~ such claims derive from human weakness and imperfection?

Over the years I've continued to spend ~~some~~ *much* time on the UFO problem. I receive many letters about it, frequently with detailed, anecdotal first-hand accounts. Sometimes momentous revelations are promised if only I will call the letter writer. After I give lectures -- on almost any subject -- I often get asked, "Do you believe in UFOs?" I'm always struck by how the question is phrased, the suggestion that this is a matter of belief and not of evidence. I'm almost never asked, "How good is the evidence that UFOs are alien spaceships?"

I've found that the going-in attitude of many people is highly pre-determined. Some are convinced that eyewitness testimony is reliable, that people do not make things up, that hallucinations ^{or hoaxes} on such a scale are impossible, and that there must be a long-standing, high-level government conspiracy to keep the truth from the rest of us. Gullibility about UFOs thrives on widespread mistrust of government, arising naturally enough from all those circumstances where -- in the tension between public well-being and "national security" -- the government lies. As government deceit and conspiracies of silence have been exposed on so many other matters, it's hard to argue that a cover-up on this strange subject is impossible, that the government would never hide important information from its citizens. A common argument on why there should be a cover-up is to prevent panic or erosion of confidence in the government.

I was a member of the U.S. Air Force committee that investigated the Air Force's UFO study -- called "Project Bluebook," but earlier and revealingly called "Project Grudge." We found the on-going effort to be lackadaisical and dismissive. In the middle 1960s, "Project Bluebook" was headquartered at Wright-Patterson Air Force Base in Ohio -- where "Foreign Technical Intelligence" (chiefly, understanding what new weapons the Soviets had) was also based. They had state-of-the-art technology in file retrieval. You asked about a given incident and, somewhat like sweaters and suits at the dry cleaner's today,

reams of files made their way past you, until the engine stopped when the file you wanted arrived at your side.

But what was in those files wasn't worth very much. For example, senior citizens reported lights hovering over their small New Hampshire town for more than an hour, and the case is explained as a wing of strategic bombers from a nearby Air Force base on a training exercise. Could the bombers take an hour to pass over the town? No. Did the bombers fly over at the time the UFOs were reported? No. Can you explain to us, Colonel, how strategic bombers can be described as "hovering"? No. The slipshod Bluebook investigations played little scientific role, but they did serve the important bureaucratic purpose of convincing some of the public that the Air Force was on the job; and that maybe there was nothing to UFO reports.

Of course, this doesn't preclude the possibility that there was another, more serious, more scientific study of UFOs going on elsewhere -- headed, say, by a brigadier general rather than a lieutenant colonel. I think something like this is even likely, not because I believe we're being visited by aliens, but because hiding in the UFO phenomena must be data once of significant military interest. Certainly if UFOs are as reported -- very fast, very maneuverable craft -- there is a military duty to find out how they work. If UFOs were built by the Soviet Union -- then portrayed, rightly or wrongly, as a menace to the American way of life -- it was the Air Force's responsibility to protect

us. Considering the remarkable performance characteristics reported, the strategic implications of the idea that Soviet UFOs were flagrantly overflying American military and nuclear facilities were worrisome. If on the other hand the UFOs were built by extraterrestrials, we might copy the technology (if we could only get our hands on just one saucer) and secure a huge advantage in the Cold War. And even if the military believed that UFOs ~~had nothing to do either with Soviets or~~ ^{were manufactured neither by} ~~nor by~~ extraterrestrials, there was a good reason to follow these reports closely:

In the 1950s balloons were being widely used by the Air Force -- not just as weather measurement platforms, as prominently advertised, and radar reflectors, as acknowledged, but also, secretly, as robotic espionage craft, with high-resolution cameras and signal intelligence devices. While the balloons themselves were not very secret, the reconnaissance packages they carried were. Balloons seem saucer-shaped when seen from the ground. If you misestimate how far away they are, you can easily imagine them going absurdly fast. Occasionally, propelled by a gust of wind, they make swift changes in direction, uncharacteristic of aircraft and in seeming defiance of Newton's first law of motion -- if you don't realize that they are hollow and weigh almost nothing.

The most famous of these military balloon systems, widely tested over the United States in the early 1950s, was called

"Skyhook." Other balloon systems and projects were designated "Mogul," "Moby Dick," "Grandson," and "Genetrix."

Urner Lidell, who had some responsibility for these missions at the Naval Research Laboratory, and who was later a NASA official, once told me he thought all UFO reports were due to military balloons. While "all" is going too far, their role has, I think, been insufficiently appreciated. So far as I know there has never been a systematic and intentional control experiment -- in which high-altitude balloons were secretly released and tracked, and UFO reports from visual and radar observers noted.

In 1956 overflights of the Soviet Union by U.S. reconnaissance balloons began. At their peak there were dozens of balloon launches a day. Balloon overflights were then replaced by high-altitude aircraft, such as the U-2, which in turn were largely replaced by reconnaissance satellites. Many UFOs dating from this period were clearly high-altitude balloons, as are some since. High-altitude balloons are still being launched -- including platforms carrying cosmic ray sensors, optical and infrared telescopes, radio receivers probing the cosmic background radiation, and other instruments above most of the Earth's atmosphere.

A great to-do has been made of one or more alleged crashed flying saucers near Roswell, New Mexico in 1947. Some initial reports and newspaper photographs of the incident are entirely consistent with the idea that the debris was a crashed high-

altitude balloon. But other residents of the region -- especially decades later -- remember more exotic materials, enigmatic hieroglyphics, threats by military personnel to witnesses if they didn't keep what they knew to themselves, and the canonical story that the alien machinery and body parts were packed into an airplane and flown to the Air Materiel Command at Wright Patterson Air Force Base. Some, but not all, of the recovered alien body stories are associated with this incident.

Philip Klass, a long-time and dedicated UFO skeptic, has uncovered a subsequently declassified letter dated July 27, 1948, a year after the Roswell "incident," from Major General C. B. Cabell, then Director of Intelligence for the U.S. Air Force (and ^{as a CIA official,} later a major figure in the abortive U.S. invasion of Cuba at the Bay of Pigs), inquiring of those who report to him what UFOs might be. He hadn't a clue. In an October 11, 1948 summary response -- explicitly including information in the possession of the Air Materiel Command -- we find that the Director of Intelligence was told that nobody else in the Air Force had a clue either. This makes it unlikely that UFO fragments and occupants had made their way to Wright Patterson a year before.

What the Air Force was mostly worried about was that UFOs were Russian. Why Russians would be testing flying saucers over the United States was a puzzle to which the following four answers were proposed: "(1) To negate U.S. confidence in the atom bomb as the most advanced and decisive weapon in warfare.

(2) To perform photographic reconnaissance missions. (3) To test U.S. air defenses. (4) To conduct familiarization flights [for strategic bombers] over U.S. territory." We now know that UFOs neither were nor are Russian, and ^{however dedicated the Soviet} ~~whatever~~ interest ~~the Soviets~~ may have ^{been} ~~had~~ in (1) through (4), flying saucers weren't how they pursued these goals.

Much of the evidence regarding the Roswell "incident" seems to point to a high-altitude classified balloon, perhaps launched from nearby White Sands Proving Ground, that crashed near Roswell, the debris of secret instruments hurriedly collected by earnest military personnel, early press reports announcing that it was a spaceship from another planet ("RAAF Captures Flying Saucer on Ranch in Roswell Region"), diverse recollections simmering over the years, and memories refreshed by the opportunity for a little fame and fortune. (Two UFO museums in Roswell are leading tourist stops.)

A 1994 report ordered by the Secretary of the Air Force and the Department of Defense in response to prodding from a New Mexico Congressman identifies the Roswell debris as remnants of a ^{highly-secret,} long-range, balloon-borne low frequency acoustic detection system called "Project Mogul" -- an attempt to sense signatures of Soviet nuclear weapons explosions at tropopause altitudes. The Air Force investigators, rummaging comprehensively through the secret files of 1947, found no evidence of heightened message traffic:

There were no indications and warnings, notice of alerts, or

a higher tempo of operational activity reported that would be logically generated if an alien craft, whose intentions were unknown, entered U.S. territory. . . . The records indicate that none of this happened (or if it did, it was controlled by a security system so efficient and tight that no one, U.S. or otherwise, has been able to duplicate it since. If such a system had been in effect at the time, it would have also been used to protect our atomic secrets from the Soviets, which history has shown obviously was not the case.).

The radar targets carried by the balloons were partly manufactured by novelty and toy companies in New York, whose inventory of decorative icons seems to have been remembered as alien hieroglyphics many years after the fact.

The heyday of UFOs corresponds to the time when the main delivery vehicle for nuclear weapons was being switched from aircraft to missiles. An early and important technical problem concerned re-entry -- returning a nuclear-armed nosecone through the bulk of the Earth's atmosphere without burning it up in the process (as small asteroids and comets are destroyed in their passage through the upper air). Certain materials, nosecone geometries, and angles of entry are better than others. Observations of re-entry (or the more spectacular launches) could very well reveal U.S. progress in this vital strategic technology or, worse, inefficiencies in the design; such observations might suggest what defensive measures an adversary should take. Understandably, the subject was considered highly sensitive.

Very likely there were cases in which military personnel were told not to talk about what they had seen, or where seemingly innocuous sightings were suddenly classified top secret

with severely constrained need-to-know criteria. Air Force officers and civilian scientists thinking back on it in later years might very well conclude that the government had engineered a UFO cover-up. If nosecones are judged UFOs, the charge is a fair one.

Consider spoofing. In the strategic confrontation between the United States and the Soviet Union, the adequacy of air defenses was a vital issue. It was item (3) on General Cabell's list. If you could find a weakness, it might be the key to "victory" in an all-out nuclear war. The only sure way to test your adversary's defenses is to fly an aircraft over their borders and see how long it takes for them to notice. The United States did this routinely to test Soviet air defenses.

In the 1950s and '60s, the United States had state-of-the-art radar defense systems covering its west and east coasts, and especially its northern approaches (over which a Soviet bomber or missile attack would most likely come). But there was a soft underbelly -- no significant early warning system to detect the geographically much more taxing southern approach. This is of course information vital for a potential adversary. It immediately suggests a spoof: ^{One or more} ~~A few~~ of the adversary's high-performance aircraft zoom out of the Caribbean, let's say, into U.S. airspace, penetrating, let's say, a few hundred miles up the Mississippi River until a U.S. air defense radar locks on. Then the intruders hightail it out of there. (Or, as a control

experiment, a unit of U.S. high-performance aircraft is sequestered and sent in unannounced sorties to see how porous American air defenses are.) In such a case, there may be combined visual and radar sightings by military and civilian observers and large numbers of independent reports. What is reported corresponds to no known aircraft. The Air Force and civilian aviation authorities truthfully state that none of their aircraft was responsible. Even if they've been urging Congress to fund a southern Early Warning System, the Air Force is unlikely to admit that Soviet or Cuban aircraft got to New Orleans, much less Memphis, before anybody caught on.

Here again, we have every reason to expect a high-level technical team investigating spoofs, Air Force and civilian observers told to keep their mouths shut, and not just the appearance but the reality of suppression of the data. Again, this conspiracy of silence need have nothing to do with alien spacecraft. Even decades later, there are ^{bureaucratic} practical reasons for the Department of Defense to be close-mouthed about such embarrassments. There is a potential conflict of interest between parochial concerns of the Department of Defense and the solution of the UFO enigma.

In addition, something that both the Central Intelligence Agency and the U.S. Air Force worried about then was UFOs as a means of clogging communication channels in a national crisis, and confusing visual and radar sightings of enemy aircraft -- a

signal-to-noise problem that in a way is the flip side of spoofing.

In view of all this, I'm perfectly prepared to believe that at least some UFO reports and analyses, and perhaps voluminous files, have been made inaccessible to the public which pays the bills. The Cold War is over, the technology is largely obsolete or widely available, and those who would be embarrassed are no longer on active duty. The worst that would happen, from the military's point of view I suspect, is that there would be one more instance of the American public being misled or lied to in the interest of national security. It's time for the files to be declassified and made generally available.

Another instructive intersection of the conspiracy temperament and the secrecy culture concerns the National Security Agency. This organization monitors the telephone, radio, and other communications of both friends and adversaries of the United States. Surreptitiously, it reads the world's mail. Its daily intercept traffic is huge. In times of tension, vast arrays of NSA personnel fluent in the relevant languages are sitting with earphones, monitoring in real time everything from encrypted commands of the target nation's General Staff to pillow talk. For other material there are key words by which computer monitors cull out for human attention specific messages or conversations of current urgent concern. Everything is stored, so that retrospectively it is possible to go back to the magnetic

tapes -- to trace the first appearance of a codeword, say, or command responsibility in a crisis. Some of the intercepts are made from listening posts in nearby countries -- Turkey for Russia, India for China, -- from aircraft and ships patrolling nearby, or from satellites in Earth orbit. There is a constant dance of measures and countermeasures between the NSA and the security services of other nations, who understandably do not wish to be listened in on.

Now add to this already heady mix the Freedom of Information Act. A request is made to the NSA for all information it has available on UFOs. It is required by law to be responsive, but of course without revealing "methods and sources." NSA also feels a deep obligation not to alert other nations, friends or foes, in an obtrusive and politically embarrassing way of its activities. So a more or less typical intercept released by NSA in response to an FOIA request will be a third of a page blacked out, a fragment of a line saying "reported a UFO at low altitude," followed by two-thirds of a page blacked out. The NSA's position is that releasing the rest of the page would potentially compromise sources and methods, or at least alert the nation in question to how readily its aviation radio traffic is being intercepted. (If NSA released surrounding, bland aircraft-to-tower transmissions, it would then be possible for the nation in question to recognize that its air traffic control dialogues are being monitored and to switch to communications means --

frequency hopping, for example -- which make NSA intercepts more difficult.) But UFO conspiracy theorists receiving, in response to their FOIA requests, hundreds of pages of material, almost all of it blacked out, understandably deduce that the NSA has extensive information on UFOs and is part of a conspiracy of silence.

not for attribution
In talking ~~off the record~~ with ~~high~~ NSA officials, I am told the following story: Typical intercepts are of military and civilian aircraft radioing that they see a UFO, by which they mean an unidentified object in the surrounding airspace. It may even be U.S. aircraft on reconnaissance or spoofing missions. In most cases it is something much more ordinary, and the clarification is also reported on later NSA intercepts.

Similar logic can be used to make NSA seem a part of any conspiracy. For example, they say, a response was required to an FOIA request on what the NSA knew about the singer Elvis Presley. It knew a few things. For example, a report on the economic health of a certain nation reported how many Elvis Presley tapes and CDs were sold. This information also was supplied as a few lines of clear in a vast ocean of censorship black. Was NSA engaged in an Elvis Presley cover-up? While of course I have not personally investigated NSA's UFO-related traffic in ~~clear~~, their story seems to me very plausible.

If we are convinced that the government is keeping visits of aliens from us, then we should take on the secrecy culture of the

military and intelligence establishments. At the very least we can push for declassification of relevant information from decades ago -- of which the July 1994 Air Force report on the "Roswell Incident" is a good example.

You can catch a flavor of the paranoid style of many UFOlogists, as well as a naiveté about the secrecy culture, in a book by a former New York Times reporter, Howard Blum [Out

There]:

Some information is classified legitimately; as with Cold War strategic systems, secrecy sometimes really is in the national interest.

I could not, no matter how inventively I tried, avoid slamming into sudden dead ends. The whole story was always lingering, deliberately, I came to believe, just out of my grasp.

Why?

This was the single, practical, impossible question that was balanced ominously on the tall peak of my mounting suspicions. Why were all these official spokesmen and institutions doing their collusive best to hinder and obstruct my efforts? Why were stories true one day, and false the next? Why all the tense, unyielding secretiveness? Why were military intelligence agents spreading disinformation, driving UFO believers mad? What had the government found out there? What was it trying to hide?

Of course there's resistance. ^m Military, political, and intelligence communities tend to value secrecy for its own sake. It's a way of silencing critics and evading responsibility -- for incompetence or worse. It generates an elite, a band of brothers in whom the national confidence can be reliably vested, unlike the great mass of citizenry on whose behalf the information is presumably made secret in the first place. With ~~perhaps~~ a few exceptions, secrecy is deeply incompatible with democracy and with science.

However, a cover-up to keep knowledge of extraterrestrial life or alien abductions almost wholly secret for 45 years, with hundreds if not thousands of government employees privy to it, is another matter. It's a remarkable notion. Certainly, government secrets are routinely kept, even secrets of substantial general interest. But the ostensible point of such secrecy is to protect the country and its citizens. Here, though, it's different. The alleged conspiracy of those with security clearances is to keep from the citizenry knowledge of a continuing alien assault on the human species. If extraterrestrials really were abducting millions of us, it would be much more than a matter of national security. It would impact the security of all human beings everywhere on Earth. Given such stakes, is it plausible that no one with real knowledge and evidence, in nearly 200 nations, would blow the whistle, speak out and side with the humans rather than the aliens?

Since the end of the Cold War NASA has been flailing about, trying to find missions that justify its existence -- particularly a good reason for humans in space. If the Earth were being visited daily by hostile aliens, wouldn't NASA leap on this opportunity to augment its funding? And if an alien invasion were in progress, why would the Air Force, traditionally led by pilots, step back from manned spaceflight and launch all its payloads on unmanned boosters?

Consider the former Strategic Defense Initiative Organization, in charge of "Star Wars." It's fallen on hard times now, particularly its objective of basing defenses in space. Its name and perspective have been demoted. It's the Ballistic Missile Defense Organization these days. It no longer even reports directly to the Secretary of Defense. The inability of such technology to protect the United States against a massive attack by nuclear-armed missiles is manifest. But wouldn't we want to at least attempt defenses in space if we were facing alien invasion? The Department of Defense, like similar ministries in every nation, thrives on enemies, real or imagined. It is implausible in the extreme that the existence of such an adversary would be suppressed by the very organization that would most benefit from its presence. The entire post-Cold War posture of the military and civilian space programs of the United States (and other nations) speaks powerfully against the idea that there are aliens among us -- unless, of course, the news is also being kept from those who plan the national defense.

* * *

Just as there are those who accept every UFO report at face value, there are also those who dismiss the idea of alien visitation out of hand and with great passion. It is, they say, unnecessary to examine the evidence, and "unscientific" even to

contemplate the issue. I once helped to organize a public debate at the annual meeting of the American Association for the Advancement of Science between proponent and opponent scientists of the proposition that some UFOs were spaceships; whereupon a distinguished physicist, whose judgment in many other matters I respected, threatened to sic the Vice President of the United States on me if I persisted in this madness. (Nevertheless, the debate was held and published, the issues were a little better clarified, and I did not hear from Spiro T. Agnew.)

A 1969 study by the National Academy of Sciences, while recognizing that there are reports "not easily explained," concluded that "the least likely explanation of UFOs is the hypothesis of extraterrestrial visitations by intelligent beings." Think of how many other "explanations" there might be: time travelers; demons from witchland; tourists from another dimension -- like Mr. Mxyztplk (or was it Mxyzptlk?; I always forget) from the land of Zrfff in the Fifth Dimension in the old Superman comic books; the souls of the dead; a "noncartesian" phenomenon that doesn't obey the rules of science or even of logic. Each of these "explanations" has been seriously proffered. "Least likely" is really saying something. This rhetorical excess is an index of how distasteful the whole subject has become to many scientists.

It's telling that emotions can run so high on a matter about which we really know so little. This is especially true of the

more recent flurry of alien abduction reports. After all, if true, either hypothesis -- invasion by extraterrestrials or an epidemic of hallucinations -- teaches us something we certainly ought to know about. Maybe the reason for strong feelings is that both alternatives have such unpleasant implications.

[Box:]

Aurora

The number of reports and their consistency suggest that there may be some basis for these sightings other than hallucinogenic drugs.

-- Mystery Aircraft, report, Federation of American Scientists, August 20, 1992

Aurora is a high-altitude, extremely secret American reconnaissance aircraft -- a successor to the U-2 and the SR-71 Blackbird. It either exists or it doesn't. By 1993, there were reports by observers near California's Edwards Air Force Base and Groom Lake, Nevada, where experimental aircraft for the Department of Defense are tested, that seemed by and large mutually consistent. Confirming reports were filed from all over the world. Unlike its predecessors, the aircraft is said to be hypersonic, to travel much faster, perhaps 6 to 8 times faster, than the speed of sound. It leaves an odd contrail described as "donuts-on-a-rope." Perhaps it is also a means of launching small secret satellites into orbit, developed, it is speculated, after the Challenger disaster indicated the shuttle's unreliability for defense payloads. But the CIA "swears up and down there's no such program," says U.S. Senator and former astronaut John Glenn. A Secretary of the Air Force has vehemently denied the existence of such an airplane, or any

^{principal}
The designer of some of the most secret U.S. aircraft says the same thing.

program to build one, in the U.S. Air Force or anywhere else. Would he lie? "We have looked into all such sightings, as we have for UFO reports," says an Air Force spokesman, "and we cannot explain them."

Consider then the two possibilities: that Aurora exists, and that it does not. If it exists, it's striking that an official cover-up of its very existence has been attempted, that secrecy could be so effective, and that the aircraft could be tested or refueled all over the world without a single photograph of it or any other hard evidence being published. On the other hand, if Aurora does not exist, it's striking that a myth has been propagated so vigorously, and gone so far. Why should insistent official denials have carried so little weight? Could the very existence of a designation -- Aurora in this case -- serve to pin a common label on a range of diverse phenomena? Either way, Aurora seems relevant to UFOs.

[M, 11/28/94]

Chapter 6

HALLUCINATIONS

[A]s children tremble and fear everything in the blind darkness, so we in the light sometimes fear what is no more to be feared than the things children in the dark hold in terror. . .

-- Lucretius, On the Nature of Things (ca. 60 B.C.)

Advertisers must know their audiences. It's a simple matter of product and corporate survival. So we can learn how commercial, free enterprise America views UFO buffs by examining the advertisements in magazines devoted to UFOs. Here are some (entirely typical) ad headlines from an issue of UFO Universe:

- Senior Research Scientist Discovers 2,000-Year-Old Secret to Wealth, Power, and Romantic Love.

- Classified! Above Top Secret. The Most Sensational Government Conspiracy of Our Time Is Finally Revealed to the World by a Retired Military Officer.

- What Is Your "Special Mission" While on Earth? The Cosmic Awakening of Light Workers, Walk-Ins, & All Star-Born Representatives Has Begun!

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- Men in Black: Government Agents or Aliens?

- Increase the Power of Gemstones, Charms, Seals and Symbols. Improve the Effectiveness of Everything You Do. Magnify Your Mind Power and Abilities with the Mind Power MAGNIFIER.

- The Famous Money Magnet: Would You Like More Money?

- Testament of Lael, Sacred Scriptures of a Lost Civilization.

- A New Book by "Commander X" from Inner Light: The Controllers, the Hidden Rulers of Earth Identified. We Are the Property of an Alien Intelligence!

What is the common thread that binds these ads together? Surely it's the expectation of unlimited audience gullibility. That's why they're placed in UFO magazines -- because by and large the very act of buying such a magazine so categorizes the reader. Doubtless, there are moderately skeptical and fully rational purchasers of ^{these} ~~such~~ periodicals who are demeaned by such expectations of advertisers and editors. But if they're right

even about the bulk of their readers, what might it mean for the alien abduction paradigm?

Occasionally, I get a letter from someone who is in "contact" with extraterrestrials. I am invited to "ask *them* anything." And so over the years I've prepared a little list of questions. The extraterrestrials are very advanced, remember. So I ask things like, "Please provide a short proof of Fermat's Last Theorem." Or the Goldbach Conjecture. And then I have to explain what these are, because extraterrestrials will not call it Fermat's Last Theorem. So I write out the simple equation with the exponents. I never get an answer. On the other hand, if I ask something like "Should we be good?" I almost always get an answer. Anything vague, especially involving conventional moral judgments, these aliens are extremely happy to respond to. But on anything specific, where there is a chance to find out if they actually know anything beyond what most humans know, there is only silence. Something can be deduced from this differential ability to answer questions.

In the good old days before the alien abduction paradigm, people taken aboard UFOs were offered, so they reported, edifying lectures on the dangers of nuclear war. Nowadays, when such instruction is given, the extraterrestrials seem fixated on environmental degradation and AIDS. How is it, I ask myself, that UFO occupants are so bound to fashionable or urgent concerns on this planet? Why not even an incidental warning about CFCs

and ozone depletion in the 1950s, or about the HIV virus in the 1970s, when it might really have done some good? Why not alert us now to some public health or environmental threat we haven't yet figured out? Can it be that aliens know only as much as those who report their presence? And if one of the chief purposes of alien visitations is admonitions about global dangers, why tell it only to a few people whose accounts are suspect anyway? Why not take over the television networks for a night, or appear with vivid cautionary audiovisuals before the United Nations Security Council? Surely this is not too difficult for those who wing across the light years.

* * *

The earliest commercially successful UFO "contactee" was George Adamski. He operated a tiny restaurant at the foot of California's Mount Palomar, and set up a small telescope out in back. At the summit of the mountain was the largest telescope on Earth, the 200-inch reflector of the Carnegie Institution of Washington and the California Institute of Technology. Adamski styled himself Professor Adamski of Mount Palomar Observatory. He published a book -- it caused quite a sensation, I recall -- in which he described how in the desert nearby he had encountered nice-looking aliens with long blond hair and, if I remember correctly, white robes who warned Adamski about the dangers of

nuclear war. They hailed from the planet Venus (whose 900° Fahrenheit surface temperature we can now recognize as a barrier to Adamski's credibility). In person, he was utterly convincing. The Air Force officer nominally in charge of UFO investigations at the time described Adamski in these words:

To look at the man and to listen to his story you had an immediate urge to believe him. Maybe it was his appearance. He was dressed in well worn, but neat, overalls. He had slightly graying hair and the most honest pair of eyes I've ever seen.

Adamski's star slowly faded as he aged, but he self-published other books and was a long-standing fixture at conventions of flying saucer "believers."

The first alien abduction story in the modern genre was that of Betty and Barney Hill, a New Hampshire couple -- she a social worker and he a Post Office employee. During a late-night drive in 1961 through the White Mountains, Betty spotted a bright, initially star-like UFO that seemed to follow them. Because Barney feared it might harm them, they left the main highway for narrow mountain roads, arriving home two hours later than they'd expected. The experience prompted Betty to read a book that described UFOs as spaceships from other worlds; their occupants were little men who sometimes abducted humans.

Soon after, she experienced a terrifying, repetitive nightmare in which she and Barney were abducted and taken aboard the UFO. Barney overheard her describing this dream to friends, coworkers, and volunteer UFO investigators. (It's curious that

Betty didn't discuss it with her husband directly.) By a week or so after the experience, they were describing a "pancake"-like UFO with uniformed figures seen through the craft's transparent windows.

Several years later, Barney's psychiatrist referred him to a Boston hypnotherapist, Benjamin Simon, M.D. Betty came to be hypnotized as well. Under hypnosis they separately filled in details of what had happened during the "missing" two hours: They watched the UFO land on the highway, and were taken, partly immobilized, inside the craft -- where short, gray, humanoid creatures with long noses (a detail discordant with the current paradigm) subjected them to unconventional medical examinations, including a needle in her navel (before amniocentesis had been invented on Earth). There are those who now believe that eggs were taken from Betty's ovaries and sperm from Barney, although that isn't part of the original story.* The captain showed Betty a map of interstellar space with the ship's routes marked.

Martin S. Kottmeyer has shown that many of the motifs in the Hills' account can be found in a 1953 motion picture, "Invaders from Mars." And Barney's story of what the aliens looked like, especially their enormous eyes, emerged in a hypnosis session just twelve days after the airing of an episode of the television

*In more recent times, Ms. Hill has written that in real alien abductions, "no sexual interest is shown. However, frequently they help themselves to some of [the abductee's] belongings, such as fishing rods, jewelry of different types, eyeglasses or a cup of laundry soap."

series "The Outer Limits" in which such an alien was portrayed.

The Hill case was widely discussed. It was made into a 1975 TV movie that introduced the idea that short, gray alien abductors are among us into the psyches of millions of people. But even the few scientists of the time who thought that some UFOs might in fact be alien spaceships were wary. The alleged encounter was prominent by its absence from the list of suggestive UFO cases compiled by James E. McDonald, a University of Arizona atmospheric physicist. Indeed, those scientists who have taken UFOs seriously have tended to keep the alien abduction accounts at arm's length -- while those who take alien abductions at face value see little reason to analyze mere lights in the sky.

McDonald's views ^{was} on UFOs ~~were~~ based, he said, not on ^{was ~~were~~ a conclusion of last resort;} irrefutable evidence, but ¹ because ~~all~~ the alternative explanations seemed to him even less credible. In the middle 1960s I arranged for McDonald to present his best cases in a private meeting with leading physicists and astronomers who had not before staked a claim on the UFO issue. Not only did he fail to convince them that we were being visited by extraterrestrials; he failed even to excite their interest. And this was a group with a very high wonder quotient. It was simply that where McDonald saw aliens, they saw much more prosaic explanations.

I was glad to have an opportunity to spend several hours with Mr. and Mrs. Hill and with Dr. Simon. There was no

mistaking the earnestness and sincerity of Betty and Barney, and their mixed feelings about becoming public figures under such odd and awkward circumstances. With the Hills' permission, Simon played for me (and, at my invitation, McDonald) some of the audiotapes of their sessions under hypnosis. By far my most striking impression was the absolute terror in Barney's voice as he described -- re-lived would be a better word -- the encounter.

Simon, while a leading proponent of the virtues of hypnosis in war and peace, had not been caught up in the rampant public interest in UFOs. He shared handsomely in the royalties of John Fuller's best-seller, Interrupted Journey, about the Hills' experience. If Simon had pronounced their account authentic, the sales of the book might have gone through the roof and his own financial reward been considerably augmented. But he didn't. He also instantly rejected the notion that they were lying, or, as suggested by other psychiatrists, that this was a folie à deux -- a shared delusion in which, generally, the submissive partner goes along with the delusion of the dominant partner. So what's left? The Hills, said their psychotherapist, had experienced a species of "dream." Together.

* * *

There may very well be more than one source of alien abduction accounts, just as there are for UFO sightings. Let's

More rarely, people ^{sense} ~~smell~~ ^{haunting} an aroma, or hear music, ^{receive} or witness a revelation that arrives independent of the senses. 9

["Hallucinations" (M, 11/28/94)]

run through some of the possibilities:

In 1894 The International Census of Waking Hallucinations was published in London. From that time to this, repeated surveys have shown that 10 to 25 percent of ordinary, functioning people have experienced, at least once in their lifetimes, a vivid hallucination -- hearing a voice, usually, or seeing a form when there's no one there. In some cases these become transforming personal events or profound religious experiences. Hallucinations may be a neglected low door in the wall to a scientific understanding of the sacred.

Much more prosaic hallucinations are more common. Probably a dozen times since their deaths I've heard my mother or father, in a conversational tone of voice, call my name. Of course they called to me often during my life with them -- to do a chore, to come to dinner, to hear about an event of the day. I still miss them so much that it doesn't seem at all strange that my brain will occasionally retrieve a lucid recollection of their voices.

Such hallucinations may occur to perfectly normal people under perfectly ordinary circumstances. Hallucinations can also be elicited: by a campfire at night, or under emotional stress, or during epileptic seizures or migraine headaches or high fever, or by prolonged fasting or sleeplessness** or sensory

** Dreams are associated with a state called REM sleep, the abbreviation standing for rapid eye movement. (Under the closed eyelids the eyes move, perhaps following the action in the dream.) The REM state is strongly correlated with sexual arousal. Experiments have been performed in which sleeping subjects are awakened whenever the REM state emerges, while

deprivation (for example, in solitary confinement), or through hallucinogens such as LSD, psilocybin, mescaline, hashish, or ethyl alcohol. (Delirium tremens, the dreaded alcohol-induced "DTs," is one well-known manifestation.) There are also molecules, such as the benzodiazepines (valium, for example), that make hallucinations go away. It is very likely that the -- perhaps including the morphine-like small proteins called endorphins -- normal human body generates substances that cause hallucinations, and others that suppress them. Such celebrated (and unhysterical) explorers as Admiral Richard Byrd, Captain Joshua Slocum, and Sir Ernest Shackleton all experienced vivid hallucinations when coping with unusual isolation and loneliness.

Whatever their neurological and molecular antecedents, hallucinations feel real. They are sought out in many cultures, and considered a sign of spiritual enlightenment. Among the Native Americans of the Western Plains, for example, or many indigenous Siberian cultures, a young man's future was foreshadowed by the nature of the hallucination he experienced after a successful "vision quest"; its meaning was discussed with great seriousness among the elders and shamans of the tribe. Alkaloid-induced religious experiences were a hallmark of the Western youth culture of the 1960s. The experience, however

members of a control group are awakened just as often each night but not when they're dreaming. After some days, the control group is a little groggy, but the experimental group -- the ones who are prevented from dreaming -- is hallucinating in daytime. It's not that a few people with a particular abnormality can be made to hallucinate in this way; anyone is capable of hallucinations.

brought about, is sometimes described respectfully by words such as "transcendent," "numinous," ^{"sacred"} and "holy."

Hallucinations are common. If you have one, it doesn't mean you're crazy. The anthropological literature is replete with hallucination ethnopsychiatry, REM dreams, and possession trances, which have many common elements transculturally and across the ages. The hallucinations are most often interpreted as possession by spirits or demons. The Yale anthropologist Weston La Barre goes so far as to argue that "a surprisingly good case could be made that much of culture is hallucination," and that "the whole intent and function of ritual appears to be. . . [a] group wish to hallucinate reality."

Here is a description of hallucinations as a signal-to-noise problem by Louis J. West, former medical director of the Neuropsychiatric Clinic at the University of California, Los Angeles. It is taken from the 15th edition of the Encyclopaedia Britannica:

[I]magine a man standing at a closed glass window opposite his fireplace, looking out at his garden in the sunset. He is so absorbed by the view of the outside world that he fails to visualize the interior of the room at all. As it becomes darker outside, however, images of the objects in the room behind him can be seen reflected dimly in the window glass. For a time he may see either the garden (if he gazes into the distance) or the reflection of the room's interior (if he focusses on the glass a few inches from his face). Night falls, but the fire still burns brightly in the fireplace and illuminates the room. The watcher now sees in the glass a vivid reflection of the interior of the room behind him, which appears to be outside the window. This illusion becomes dimmer as the fire dies down, and, finally, when it is dark both outside and within, nothing more is seen. If the fire flares up from time to time, the visions in the glass reappear.

In an analogous way, hallucinatory experiences such as those of normal dreams occur when the "daylight" (sensory input) is reduced while the "interior illumination" (general level of brain arousal) remains "bright," and images originating within the "rooms" of our brains may be perceived (hallucinated) as though they came from outside the "windows" of our senses.

Another analogy might be that dreams, like the stars, are shining all the time. Though the stars are not often seen by day, since the sun shines too brightly, if, during the day, there is an eclipse of the sun, or if a viewer chooses to be watchful awhile after sunset or awhile before sunrise, or if he is awakened from time to time on a clear night to look at the sky, then the stars, like dreams, though often forgotten, may always be seen.

A more brain-related concept is that of a continuous information-processing activity (a kind of "preconscious stream") that is influenced continually by both conscious and unconscious forces and that constitutes the potential supply of dream content. The dream is an experience during which, for a few minutes, the individual has some awareness of the stream of data being processed. Hallucinations in the waking state also would involve the same phenomenon, produced by a somewhat different set of psychological or physiological circumstances. . . .

It appears that all human behaviour and experience (normal as well as abnormal) is well attended by illusory and hallucinatory phenomena. While the relationship of these phenomena to mental illness has been well documented, their role in everyday life has perhaps not been considered enough. Greater understanding of illusions and hallucinations among normal people may provide explanations for experiences otherwise relegated to the uncanny, "extrasensory," or supernatural.

We would surely be missing something important about our own nature if we refused to face up to the fact that hallucinations are part of being human. However, none of this makes hallucinations real. Roughly 10 percent of Americans report having seen one or more ghosts. This is more than the number who allegedly remember being abducted by aliens, about the same as the number who've reported seeing one or more UFOs, and less than the number who in the last week of Richard Nixon's Presidency --

before he resigned to avoid impeachment -- thought he was doing a good-to-excellent job as President. At least one percent of all of us is schizophrenic. This amounts to over 50 million schizophrenics on the planet, more than the population of, say, England.

In his 1970 book on nightmares, the psychiatrist John Mack -- about whom I will have more to say -- writes:

There is a period in early childhood in which dreams are regarded as real and in which the events, transformations, gratifications, and threats of which they are composed are regarded by the child as if they were as much a part of his actual daily life as his daytime experiences. The capacity to establish and maintain clear distinctions between the life of dreams and life in the outside world is hard-won and requires several years to accomplish, not being completed even in normal children before ages eight to ten. Nightmares, because of their vividness and compelling affective intensity, are particularly difficult for the child to judge realistically.

When a child tells a fabulous story -- a witch was grimacing in the darkened room; a tiger is lurking under the bed; the vase was broken by a multi-colored bird that flew in the window and not because, contrary to family rules, a soccer ball was being kicked inside the house -- is he or she consciously lying? Surely parents often act as if the child cannot fully distinguish between fantasy and reality. Some children have active imaginations; others are less well endowed in this department. Some families may respect the ability to fantasize and encourage the child, while at the same time saying something like "Oh, that's not real; that's just your imagination." Other families may be impatient about confabulating -- it makes running the

household and adjudicating disputes at least marginally more difficult -- and discourage their children from fantasizing, perhaps even teaching them to think it's something shameful. A few parents may be unclear about the distinction between reality and fantasy themselves, or may even seriously enter into the fantasy. Out of all these contending propensities and child-rearing practices, some people emerge with an intact ability to fantasize, and a history, extending well into adulthood, of confabulation. Others grow up believing that anyone who doesn't know the difference between reality and fantasy is crazy. Most of us are somewhere in between: Only very rarely, though, do we confuse stories we make up with events in the outside world.

Abductees frequently report having seen "aliens" in their childhood -- coming in through the window or from under the bed or out of the closet. But everywhere in the world children report similar stories -- with fairies, elves, brownies, ghosts, ^{witches,} goblins, [^]imps, and a rich variety of imaginary "friends." Are we to imagine two different groups of children -- one that sees imaginary earthly beings and the other that sees genuine extraterrestrials? Isn't it more reasonable that both groups are seeing, or hallucinating, the same thing?

Most of us ^{recall} ~~remember~~ being frightened at the age of two and older by real-seeming but wholly imaginary "monsters," especially at night or in the dark. [↑] Part of the reason that children are afraid of the dark may be because, in our entire evolutionary

I can still remember ~~a few~~ occasions when I was absolutely terrorized, hiding under the bedclothes until I could stand it no longer, ~~and~~ then bolting for the safety of my parents' bedroom -- if only I could get there before falling into the clutches of ... The Presence.

history up until just a moment ago, they never slept alone. Instead, they nestled safely, protected by an adult -- usually mom. In the enlightened West we stick them alone in a dark room, say goodnight, and have difficulty understanding why they're sometimes upset. It makes good evolutionary sense for children to have fantasies of scary monsters. In a world stalked by lions and hyenas, such fantasies help prevent defenseless toddlers from wandering too far away from their guardians. But if we're capable of conjuring up ^{terrifying} monsters in childhood, why shouldn't some of us, at least on occasion, be able to fantasize something ~~with~~ ^{something truly horrifying,} similar as adults?

It is telling that alien abductions mainly occur on falling asleep or when waking up, or on long automobile drives where there is a well-known danger of falling into some autohypnotic reverie. Might these stories have something to do with sleep and, as Benjamin Simon proposed for the Hills, a kind of dream?

A common, although insufficiently well-known, psychological syndrome rather like alien abduction is called sleep paralysis. Many people experience it. It happens in that twilight world between being fully awake and fully asleep. For a few minutes, maybe longer, you're immobile and acutely anxious. You feel a weight on your chest as if some being is sitting or lying there. Your heartbeat is quick, your breathing labored. You may experience auditory or visual hallucinations -- of people, demons, ghosts, animals, or birds. In the right setting, the

experience can have "the full force and impact of reality," according to Robert Baker, a psychologist at the University of Kentucky. Sometimes there's a marked sexual component to the hallucination. Baker argues that these common sleep disturbances are behind many if not most of the alien abduction accounts. (He and others suggest that there are other classes of abduction claims as well, made by fantasy-prone individuals, say, or hoaxers.)

Similarly, the Harvard Mental Health Letter (September 1994) comments,

Sleep paralysis may last for several minutes, and is sometimes accompanied by vivid dreamlike hallucinations that give rise to stories about visitations from gods, spirits, and extraterrestrial creatures.

Summit Y But such a view is easy to burlesque: UFOs explained away as "mass hallucinations." Everyone knows there's no such thing as a shared hallucination. Right?

* * *

As the possibility of extraterrestrial life began to be widely popularized -- especially around the turn of the last century by Percival Lowell with his Martian canals -- people began to report contact with aliens, mainly Martians. The psychologist Theodore Flournoy's 1901 book, From India to the Planet Mars, describes a French-speaking medium who in a trance state drew pictures of the Martians (they look just like us) and

¶ We know from early work of the Canadian neuro-physiologist Wilder Penfield that electrical stimulation of certain regions of the brain elicits full-blown hallucinations. People with temporal lobe epilepsy -- involving a cascade of ~~naturally-generated~~ electrical impulses in the part of the brain beneath the forehead -- experience a range of hallucinations almost indistinguishable from reality: including the presence of one or more strange beings, ~~out-of-body experiences~~ ^{or} floating through the air, anxiety, ~~and~~ sexual experiences, ^{and a sense of missing time.} There is also ^{what feels like} ~~the sense of~~ profound insight into the deepest questions, and a need to spread the word. ~~¶~~ A continuum ^{of spontaneous temporal lobe stimulation} seems to stretch from people with serious epilepsy to the most average among us. In at least one case reported by another Canadian neuroscientist, Michael Persinger, administration of ^{the} ~~an~~ antiepileptic drug, carbamazepine, eliminated a ~~human's~~ recurring sense of experiencing the standard alien abduction scenario. So such hallucinations, generated spontaneously, or with chemical or experiential assists, ~~would seem to~~ ^{may} play a role -- perhaps a central role -- in the UFO accounts. ~~They would~~

Quant V, Ch 6, p. 16

presented their alphabet and language (remarkably like French). The psychiatrist Carl Jung in his 1902 doctoral dissertation described a young Swiss woman who was agitated to discover, sitting across from her on the train, a "star-dweller" from Mars. Martians are innocent of science, philosophy, and souls, she was told, but have advanced technology. "Flying machines have long been in existence on Mars; the whole of Mars is covered with canals," and so on. Charles Fort, a collector of anomalous reports who died in 1932, wrote, "Perhaps there are inhabitants of Mars, who are secretly sending reports upon the ways of this world to their governments." In the 1950s^[chk], there was a book by Gerald^[chk] Heard that revealed the saucer occupants to be intelligent Martian bees. Who else could survive the fantastic right angle turns reported for UFOs? *And after the surface of Venus was found to be hot enough to melt lead, there were no more*

But after the canals were shown to be illusory by Mariner 9^{visiting Venusians.} in 1971, and after no compelling evidence even for microbes was found on Mars by Vikings 1 and 2 in 1976, popular enthusiasm for the Lowellian Mars waned and we heard ~~very~~ little about visiting Martians. Aliens were then reported to come from somewhere else. Why? Why no more Martians? *Does some part of these stories* adjust to the current canons of belief?

There's no doubt that humans commonly hallucinate. There's considerable doubt about whether extraterrestrials exist, frequent our planet, or abduct and molest us. We might argue about details, but the one category of explanation is surely much

better supported than the other. The main reservation you might then have is: Why do so many people today report this particular set of hallucinations? Why somber little beings, and flying saucers, and sexual experimentation?

[M, 11/28/94]

Chapter 7

THE DEMON-HAUNTED WORLD

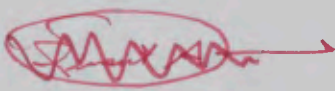
There are demon-haunted worlds, regions of utter darkness.

-- The Isa Upanishad (India, ca. 600 B.C.)

The gods watch over us and guide our destinies, many human cultures teach; other entities, more malevolent, account for the existence of evil. Both classes of beings, whether considered natural or supernatural, real or imaginary, serve human needs. Even if they're wholly fanciful, people feel better believing in them. So in an age when traditional religions have been under withering fire from science, is it not natural to wrap up the old gods and demons in scientific raiment and call them aliens?

~~Even so, reports of aliens cannot be invented out of whole cloth. Whatever our psychological predispositions, some event, some perception -- real or illusory -- must trigger them.~~

* * *



Belief in demons was widespread in the ancient world. They were thought of as natural rather than supernatural beings. Hesiod casually mentions them. Socrates described his philosophical inspiration as the work of a personal, benign demon. His teacher, Diotima of Mantinea, tells him (in Plato's Symposium) that "Everything demonic is intermediate between God

and mortal. God has no contact with man," she continues; "only through the demonic is there intercourse and conversation between man and gods, whether in the waking state or during sleep."

Plato, Socrates' most celebrated student, assigned a high role to demons: "We do not appoint oxen to be the lords of oxen, or goats of goats," he said;

but we ourselves are a superior race and rule over them. In like manner God, in his love of mankind, placed over us the demons, who are a superior race, and they with great ease and pleasure to themselves, and no less to us, taking care of us and giving us peace and reverence and order and justice never failing, made the tribes of men happy and united.

He stoutly denied that demons were a source of evil, and represented Eros, the keeper of sexual passions, as a demon, not a god, "neither mortal nor immortal," "neither good nor bad." But all later Platonists, including the Neo-Platonists who powerfully influenced Christian philosophy, held that some demons were good and others evil. The pendulum was swinging. Aristotle, Plato's famous student, seriously considered the contention that dreams are scripted by demons. Plutarch and Porphyry proposed that the demons, who filled the upper air, came from the Moon.

The early Church Fathers, despite having imbibed Neo-Platonism from the culture they swam in, were anxious to separate themselves from "pagan" belief-systems. They taught that all of pagan religion consisted of the worship of demons and men, both misconstrued as gods. St. Augustine was much vexed with demons.

He quotes the prevailing pagan thinking: "The gods occupy the loftiest regions, men the lowest, the demons the middle region. . . They have immortality of body, but passions of the mind in common with men." In Book VIII of The City of God (begun in 413), Augustine incorporates this ancient tradition, replaces gods by God, and demonizes the demons -- arguing that they are, without exception, malign. They have no redeeming virtues. They are the fount of all spiritual and material evil. He calls them "aerial animals. . . most eager to inflict harm, utterly alien from righteousness, swollen with pride, pale with envy, subtle in deceit." They may profess to carry messages between God and man, disguising themselves as angels of the Lord, but this pose is a snare to lure us to our destruction. They can assume any form, and know many things -- "demon" means "knowledge" in Greek -- especially about the material world. They prey on "the captive and outwitted minds of men," wrote Tertullian. "They have their abode in the air, the stars are their neighbors, their commerce is with the clouds."

In the eleventh century, the influential Byzantine theologian, philosopher, and shady politician, Michael Psellus, described demons in these words:

These animals exist in our own life, which is full of passions, for they are present abundantly in the passions, and their dwelling-place is that of matter, as is their rank and degree. For this reason they are also subject to passions and fettered to them.

So many women reported incubi, argued the Presbyterian ^{religious} writer Richard Baxter (in his Certainty of the World of Spirits, 1641) "that it is impudence to deny it."*

["The Demon-Haunted World" (M, 11/28/94)]

There are a number of ^{between} cases in which nuns reported, in some befuddlement, a striking resemblance ~~of~~ the incubus ^{to} the priest-confessor, or the bishop.

Despite successive waves of rationalist, Persian, Jewish,

Christian, and Moslem world views, despite revolutionary social, political, and philosophical ferment, the existence, much of the character, and even the name of demons remained unchanged from Hesiod to the Crusades.

Demons, the "powers of the air," come down from the skies and have unlawful sexual congress with women. Augustine believed that witches were the offspring of these forbidden unions. In the Middle Ages, as in classical antiquity, ^{nearly} everyone believed such stories. The demons were also called devils, or fallen angels. The demonic seducers of women were labeled incubi; of men, succubi. As they seduced, they were perceived as a weight bearing down on the chest of the dreamer. Mare, despite its Latin meaning, is the Old English word for incubus, and nightmare meant originally the demon that sits on the chests of sleepers, tormenting them with dreams. ✓

The external reality of demons was almost entirely unquestioned from antiquity through late medieval times. One of the few cases I can find that even hints that demons might be internal, generated in our minds, is when Abba Poemen -- one of the desert fathers of the early Church -- was asked,

"How do the demons fight against me?"

"The demons fight against you?" Father Poemen asked in turn.

"Our own wills become the demons, and it is these which attack us. . ."

* Likewise, in the same work, "The raising of storms by witches is attested by so many, that I think it needless to recite them." Anything that a large number of people believe ~~Baxter in effect held~~ must be true.

and awake the next morning, as one fifteenth century chronicler put it, to "find themselves polluted just as if they had committed with a man."

In Athanasius' Life of St. Anthony (written around 360) demons are described as coming and going at will in locked rooms; in his work De Daemonialitate, the Franciscan scholar Ludovico Sinistrari assures

1400 years later,

["The Demon-Haunted World" (M, 11/28/94)] us that demons pass through walls.

5

The medieval attitudes on incubi and succubi were influenced by Macrobius' fourth-century Commentary on the Dream of Scipio, which went through dozens of editions before the European Enlightenment. Macrobius described phantoms (phantasma) seen "in the moment between wakefulness and slumber." The dreamer "imagines" the phantoms as predatory. Macrobius had a skeptical side which his medieval ~~followers~~ ^{readers tended to} ignored.

Obsession with demons began to reach a crescendo when, in his famous Bull of 1484, Pope Innocent VIII declared,

It has come to Our ears that members of both sexes do not avoid to have intercourse with evil angels, incubi, and succubi, and that by their sorceries, and by their incantations, charms, and conjurations, they suffocate, extinguish, and cause to perish the births of women

as well as generate numerous other calamities. With this Bull, Innocent initiated the systematic accusation, torture, and execution of countless "witches" all over Europe. They were guilty of what Augustine had described as "a criminal tampering with the unseen world." Despite the evenhanded "members of both sexes" in the language of the Bull, unsurprisingly it was mainly girls and women who were so persecuted.

Many leading Protestants of the following centuries, their differences with the Catholic Church notwithstanding, adopted nearly identical views. Even humanists such as Desiderius Erasmus and Thomas More believed in witches. "The giving up of witchcraft," said John Wesley, the founder of Methodism, "is in effect the giving up of the Bible." William Blackstone, the

The theologian
a Meric Casaubon argued -- in his 1668 book, Of Credulity and Incredulity -- that witches must exist because everyone believes in them

celebrated jurist, in his Commentaries on the Laws of England (1765), asserted:

To deny the possibility, nay, actual existence of witchcraft and sorcery is at once flatly to contradict the revealed word of God in various passages of both the Old and New Testament.

Innocent commended "[o]ur dear sons Henry Kramer and James Sprenger," who "have been by Letters Apostolic delegated as Inquisitors of these heretical [de]pravities." If "the abominations and enormities in question remain unpunished," the souls of multitudes face eternal damnation.

The Pope appointed Kramer and Sprenger to write a comprehensive analysis, using the full academic armory of the late fifteenth century. With exhaustive citations of Scripture and of ancient and modern scholars, they produced the Malleus Maleficarum, the "Hammer of Witches" -- aptly described as one of the most terrifying documents in human history. What it comes down to, pretty much, is that if you're accused of witchcraft, you're a witch. There are no rights of the accused. There is no opportunity to confront your accusers. No one seems to have even

considered the possibility that accusations might be made for ^{or the greed of the inquisitors who confiscated the property of the} ~~or the greed of the inquisitors who confiscated the property of the~~ ^{accused.} ~~impious purposes -- jealousy, say, or revenge, or misogyny.~~ The ^{accused.}

more who, under torture, confessed to witchcraft, the harder it ^{Since each "witch" was made to implicate others, the number grew exponentially.} was to maintain that the whole business was mere fantasy. These ^{constituted}

were "frightful proofs that the Devil is still alive," as it was

later put in America in the Salem witch trials. The Bible had counseled, "Thou shalt not suffer a witch to live." Legions of

Quest X, Ch 7, p. 7

There were strong ^{erotic} ~~sexual~~ and misogynistic elements -- as might be expected in a sexually repressed, ^{male-dominated} society and inquisitors drawn from the class of nominally celibate priests. The trials paid close attention to the quality and quantity of orgasm in the supposed copulations of defendants with demons or the Devil, and to the nature of the Devil's "Devil's marks" were found "generally on the breasts or private parts" according to the Franciscan demonologist Ludovico Sinistrari in a ~~text~~ book published in 1700. As a result pubic hair was shaved, and the genitalia were carefully ^{inspected} ~~examined~~ by the exclusively male inquisitors. In the immolation of Joan of Arc, after her dress had caught fire the hangman of Rouen slaked the flames so onlookers could view "all the secrets which can or should be in a woman." And the most horrendous tortures were routinely applied to every defendant, young or old; the instruments of torture were first blessed by ^{the} priests.

Quest V, Ch 7, p. 6

¶ All costs of investigation, trial and execution were borne by the accused or her relatives -- down to per diems for the private detectives hired to spy on her, wine for her guards, a banquet for her judges, the travel expenses of a messenger sent to fetch a more experienced torturer from another city, and the tar and hangman's rope. ~~As with~~ ^{convicted} The witch's remaining property was then divided between Church and State. As this legally and morally sanctioned mass murder and theft became institutionalized, and a vast bureaucracy constructed to serve it, attention was turned from poor hags and crones to the middle class and the well-to-do of both sexes.

Quest V, Ch 7, p. 6

In a credulous age, the most fantastic testimony was soberly accepted -- that tens of thousands of witches had gathered ^{for a sabbath} in public squares in France, or that 12,000 of them darkened the skies ^{as they} ~~and~~ flew to Newfoundland.

The pin penetrated deep into the witch's flesh. When no visible marks were apparent, "invisible marks" sufficed. Upon the gallows, one mid-seventeenth-century pricker "confessed he had been the death of above 220 women in England and Scotland, for the gain of twenty shillings ["The Demon-Haunted World" (M, 11/28/94)] a piece." 7

women were burnt to death.* Innocent himself died in 1492, following unsuccessful attempts to keep him alive by transfusion (which resulted in the deaths of three boys) and by suckling at the breast of a nursing mother.

In Britain and elsewhere witch-finders, also called

He was mourned by his mistress and their children.

"prickers," were employed, receiving a handsome bounty for each

girl or ~~old~~ woman they produced. They had no ^{incentive} reason to be

cautious in their accusations.

^{Typically they looked for "devil's marks" -- scars or birthmarks or nevi -- that when pricked with a pin neither hurt nor bled. A simple slight touch and often gave the appearance that it}

It was nearly impossible to provide compelling alibis for

accused witches: The rules of evidence had a special character.

For example, in ^{more than one} several cases a husband attested that his wife

was asleep in his arms at the very ^{moment} time she was accused of

frolicking with the devil, ^{at a witch's sabbath;} but the archbishop patiently explained

that a demon had taken the place of the wife. The husbands were

not to imagine that their powers of perception could exceed

Satan's powers ^{of deception} to deceive. The beautiful young women were

perforce consigned to the flames.

Quent X

The chronicle of those who were consumed by fire in the single German city of Wurtzburg in the year 1598 penetrates the statistics and lets us confront a little of the human reality:

The steward of the senate, named Gering; old Mrs. Kanzler; the tailor's fat wife; the woman cook of Mr. Mengerdorf; a stranger; a strange woman; Baunach, a senator, the fattest citizen in Wurtzburg; the old smith of the court; an old woman; a little girl, nine or ten years old; a younger girl, her little sister; the mother of the two little aforementioned girls; Liebler's daughter; Goebel's child, the most beautiful girl in Wurtzburg; a student who knew many languages; two boys from the Minster, each twelve years old; Stepper's little daughter; the woman who kept the bridge gate; an old woman; the little son of the town

*This mode of execution was adopted by the Holy Inquisition, apparently to guarantee literal accord with a well-intentioned sentence of canon law (Council of Tours, 1163): "The Church abhors bloodshed."

In the witch trials, mitigating evidence or defence witnesses were inadmissible in any case.

They could not be mistaken. The confessions of witchcraft could not be hallucinations, say, or desperate attempts to please the satisfy the inquisitors and stop the torture. ~~In such a case, explained~~ The witch judge Pierre de Lancre (in his 1612 book A Description of the Inconstancy of Evil Angels), the Catholic Church

["The Demon-Haunted World" (M, 11/28/94)]
would be committing a great crime by burning witches. Those who raise such possibilities are ^{thus} attacking the Church and ipso facto committing mortal sin. Critics of council bailiff; the wife of Knertz, the butcher; the infant daughter of Dr. Schultz; a blind girl; Schwartz, canon at Hach. . .

On and on it goes. Some were given special humane attention:

"The little daughter of Valkenberger was privately executed and burnt." There were 28 public immolations, each with 4 to 6 victims on average, in that small city in a single year. This was a microcosm of what was happening all across Europe. No one knows how many were killed altogether -- perhaps hundreds of thousands, perhaps millions. Those responsible for prosecuting, ^{for torturing,} ~~for~~ judging, ~~for~~ burning, and ~~for~~ justifying were selfless. Just ask them. ~~They~~ were doing God's work. They were saving souls.

They were foiling demons.

Witchcraft of course was not the only offense that merited ^{torture and} burning at the stake. Heresy was ^{still} a more serious crime, and both Catholics and Protestants punished it ruthlessly. In the sixteenth century the scholar William Tyndale had the temerity to contemplate translating the New Testament into English. But if people could actually read the Bible in their own language instead of arcane Latin, they could form their own, independent religious views. This was a challenge to the job security of Roman Catholic priests. When Tyndale tried to publish his translation, he was hounded and pursued all over Europe. Eventually he was captured, garroted, and then, for good measure, burned at the stake. His copies of the New Testament (which a century later ~~check~~ became the basis of the King James

witch-burning were punished and, in some cases, themselves burnt. The inquisitors and torturers

translation) were then hunted down house-to-house by armed posses -- Christians piously defending Christianity by preventing other Christians from knowing the words of the founder of their religion. Such a cast of mind, such a climate of absolute confidence that knowledge should be rewarded by torture and death were unlikely to help those accused of witchcraft.

Burning witches is a feature of Western civilization that has, with occasional political exceptions, declined since the sixteenth century. The last judicial execution of witches in England occurred in the year 1716, when a woman and her nine-year-old daughter were hanged. Their crime was raising a rain storm by taking their stockings off. In our time, witches and djinns are found as regular fare in children's entertainment, exorcism of demons is still practiced by the Roman Catholic and other churches, and the proponents of one cult still denounce as sorcery the cultic practices of another. A crazed and violent person is still said to be demonic. (Not until the eighteenth century was mental illness no longer generally ascribed to supernatural causes; even insomnia had been considered a punishment inflicted by demons.) More than half of Americans tell pollsters they "believe" in the Devil, and ten percent have *as Martin Luther reported he did regularly-* communicated with him, a Demonology is today still part and parcel of many earnest faiths.

And what is it that demons do? In the Malleus, Kramer and Sprenger reveal that "devils. . . busy themselves by interfering

Aquinas, who tells us in his On the Trinity that "demons can transfer the semen which they have collected and inject it into the bodies of others." His contemporary, St. Bonaventura, spells it out in a little more detail: Succubi "yield to males and receive their semen; by cunning skill, the demons preserve its potency, ["The Demon-Haunted World" (M, 11/28/94)] and afterwards, with the permission of God, they become incubi and pour it out into female repositories."

with the process of normal copulation and conception, by

obtaining human semen, and themselves transferring it."

Demonic

artificial insemination in the ~~fifteenth~~ century. The products

Middle Ages goes back at least to St. Thomas

of these unholy demon-mediated unions are also, when they grow

up, visited by demons. A multi-generational trans-species sexual

bond is forged. And these creatures, we recall, are well-known

to fly; indeed they inhabit the upper air. ~~including non-human sexually ob-~~ ~~the sky, walk through walls, and perform breeding experiments on the human species.~~ ~~sessive non-humans who live in~~

There is no spaceship in these stories. But most of the

Communicate telepathically

central elements of the alien abduction account are present, ~~on~~

~~this matter, for a millennium at least, and private reservations~~

~~aside, there were nearly no skeptics. Everyone believed. Unless~~

~~we~~ believe that demons really exist, how can we understand so

strange a belief system, embraced by the whole Western world

(including those considered the wisest among us), reinforced by

personal experience in every generation, and taught by Church and

State? Is there any real alternative besides (1) demons exist,

based on common brain wiring?

or (2) this is something like a shared delusion?

In Genesis we read of angels who couple with "the daughters

of men." The culture myths of ancient Greece and Rome told of

gods appearing to women as bulls or swans or showers of gold and

impregnating them. In one early Christian tradition, philosophy

derived not from human ingenuity but out of demonic pillow talk

-- the fallen angels betraying the secrets of Heaven to their

human consorts. Accounts with similar elements appear in

cultures around the world. Parallels to incubi include Arabian

In another ^{epoch} of demon hysteria, it was easy enough to demonize those we feared or hated. So

["The Demon-Haunted World" (M, 11/28/94)]

So were Plato, ^{Alexander the Great,} Augustus, ^{Merlin} and 11
Luther.

djinn, Greek satyrs, Hindu bhuts, Samoan hotua poro, Celtic dusii, and many others. Merlin was said to have been fathered by an incubus. Occasionally an entire people -- for example the ^{or the inhabitants of Cyprus} Huns -- were ^{of ins} thought ^{accused} by their enemies to have been sired by demons.

In Talmudic tradition the archetypical succubus was Lilith, whom God made from the dust along with Adam, but ^{she} ~~who~~ was expelled from Eden for insubordination -- not to God, but to Adam. Ever since, she spends her nights seducing Adam's descendants. In ancient Iranian and many other cultures, nocturnal seminal emissions were believed to be elicited by succubi. St. Teresa of Avila reported a vivid sexual encounter with an angel -- an angel of light, not of darkness, she was sure -- as did other women later sanctified by the Catholic Church. Cagliostro, the eighteenth-century magician and con man, let it be understood that he, like Jesus of Nazareth, was a product of the union "between the children of heaven and earth."

In 1645 a Cornish teen-ager, Anne Jefferies, was found groggy, crumpled on the floor. Much later, she recalled being attacked by half-a-dozen little men, carried paralyzed to a castle in the air, seduced, and returned home. She called the little men fairies. ^A They returned to terrify and torment her. The next year she was arrested for witchcraft. Fairies traditionally have magical powers, and can cause paralysis by the merest touch. The ordinary passage of time is slowed in

^A For many pious Christians, as with the inquisitors of Joan of Arc, this was a distinction without a difference. Fairies were demons, plain and simple.)

fairyland. Fairies are reproductively impaired, so they have sex with humans and carry off babies from their cradles -- sometimes leaving a fairy substitute, a "changeling." Now it ^{'s} ~~seems~~ a fair question: If Anne Jefferies had grown up in a culture touting aliens rather than fairies, and UFOs rather than castles in the air, would her story have been distinguishable in any significant sense from the ones "abductees" tell?

And it seems to me we can recognize something similar in the great African-American spiritual,

I saw a band of angels comin' after me,
Comin' for to carry me home.
Swing low, sweet chariot. . .

Ben Truwe of Medford, Oregon has sent me an excerpt from the diary of one Willis Jackson Dean of Talent, Oregon, who at age 72, on September 14, 1915, made this "uncharacteristic" entry:

I had an experience on the night of the 10th inst entirely new to me & it has had a prominent place in my thoughts ever since. I had retired at the usual time, was at my best in health and general bodily condition, and fell asleep promptly. In about an hour, I judge, I suddenly awoke with a sort of nervous chill. The most unaccountable twitching and tingling sensation ran over & through my whole body. The twitchings seem to race rapidly up & down and round & round in a manner very difficult to describe. No pain, no fever, no chilling -- radically unlike any previous experience. At once I began to wonder what could have brought on such a malady, if so it might be termed, when -- clairaudiently perhaps -- I heard a voice remarkably clear, distinct & pleasant and the words in substance: "This is all right. No harm will come to you. We have you in charge. Come." Now the queer part of the whole strange affair is that I was not excited or disturbed in the least but promptly assented with the coolest indifference. Three persons[,] young men, led me rapidly away. We neither walked nor rode but seemed to be borne along easily & quietly and by some invisible agency. Soon we stopped in the presence of quite a number of people. On the left was a group of middle aged, & older; on the right, children; near

to and directly in front young men, my three guides being the nearest. All, excepting the older people, were eying me and smiling as if they were much pleased at something. Suddenly the leader of the three guides attracted my attention by waving his hand & nodding as much as to say, "Look and see." In wonderment I asked, mentally, Is this Spirit Land & are all these people spirits? The leader smilingly nodded in the affirmative, saying "This is Spirit Land & these people you see are indeed spirits." We then returned and I was soon myself again, the peculiar tingling sensation having entirely ceased. Now most will say that this unique experience was a dream -- a dream & nothing more. Perhaps it was but it was a long way out of the ordinary. Anyway the strange bit of experience has dominated my thoughts ever since and like Banquo's ghost will not down. So it occurred to me that making a record of it in these pages might tend to aid me in relieving the mind somewhat of almost constantly trying to make something or nothing of the strange affair.

Dean confided this experience to his diary in an age of Victorian sensibilities and sexual repression. If he lived today, would the extraordinary dream have had erotic content? Would Spirit Land have been a spaceship?

In his 1982 book The Terror That Comes in the Night: An Experience-Centered Study of Supernatural Assault Traditions, David Hufford describes an executive, university-educated, in his mid-thirties, who recalled a summer spent as a teenager in his aunt's house. One night, he saw mysterious lights moving in the harbor. Afterwards, he fell asleep. From his bed he then witnessed a white, glowing figure climbing the stairs. She entered his room, paused, and then said -- anticlimactically, it seems to me -- "That is the linoleum." Some nights the figure was an old woman; in others, it was an elephant. Sometimes the young man was convinced the entire business was a dream; other

times he was certain he was awake. He was pressed down into his bed, paralyzed, unable to move or cry out. His heart was pounding. He was short of breath. Similar events transpired on many consecutive nights. What is happening here? These events took place before alien abductions were widely described. If the young man had known about alien abductions, would his old woman have had a larger head and bigger eyes?

In several famous passages in The Decline and Fall of the Roman Empire, Edward Gibbon described the balance between credulity and skepticism in late classical antiquity:

Credulity performed the office of faith; fanaticism was permitted to assume the language of inspiration, and the effects of accident or contrivance were ascribed to supernatural causes. . .

In modern times [Gibbon is writing in the middle eighteenth century], a latent and even involuntary scepticism adheres to the most pious dispositions. Their admission of supernatural truths is much less an active consent than a cold and passive acquiescence. Accustomed long since to observe and to respect the invariable order of Nature, our reason, or at least our imagination, is not sufficiently prepared to sustain the visible action of the Deity. But in the first ages of Christianity the situation of mankind was extremely different. The most curious, or the most credulous, among the Pagans were often persuaded to enter into a society which asserted an actual claim of miraculous powers. The primitive Christians perpetually trod on mystic ground, and their minds were exercised by the habits of believing the most extraordinary events. They felt, or they fancied, that on every side they were incessantly assaulted by dæmons, comforted by visions, instructed by prophecy, and surprisingly delivered from danger, sickness, and from death itself, by the supplications of the church. . .

It was their firm persuasion that the air which they breathed was peopled with invisible enemies; with innumerable demons, who watched every occasion, and assumed every form, to terrify, and above all to tempt, their unguarded virtue. The imagination, and even the senses, were deceived by the illusions of distempered fanaticism; and the hermit, whose midnight prayer was oppressed by

But by 1628, James had become a thoroughgoing skeptic -- mainly because adolescents had been found ~~to~~ faking demonic possession, in which state they had accused innocent people of witchcraft.

["The Demon-Haunted World" (M, 11/28/94)]

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involuntary slumber, might easily confound the phantoms of horror or delight which had occupied his sleeping and his waking dreams. . .

[T]he practice of superstition is so congenial to the multitude that, if they are forcibly awakened, they still regret the loss of their pleasing vision. Their love of the marvellous and supernatural, their curiosity with regard to future events, and their strong propensity to extend their hopes and fears beyond the limits of the visible world, were the principal causes which favoured the establishment of Polytheism. So urgent on the vulgar is the necessity of believing, that the fall of any system of mythology will most probably be succeeded by the introduction of some other mode of superstition. . .

Put aside Gibbon's social snobbery: The devil tormented the upper classes too, and even a king of England -- James I, the first Stuart monarch -- wrote a credulous and superstitious book on demons (Daemonologie, 1597). ~~He~~ He also was the patron of the great translation of the Bible into English that still bears his name.³ It was King James' opinion that tobacco is the "devil's weed," and a number of witches were discovered through their addiction to tobacco. If we reckon the skepticism that Gibbon says characterized his time to have declined in ours, and if even a little of the rampant gullibility he attributes to late classical times is left over in ours, should we not expect something like demons to find a niche in the popular culture of the present?

Of course, as enthusiasts for extraterrestrial visitations are quick to remind me, there's another interpretation of these historical parallels: Aliens, they say, have always been visiting us, poking at us, stealing our sperms and eggs, impregnating us. In earlier times we recognized them as gods,

demons, fairies, or spirits; only now do we understand that it's aliens who've been diddling us all these millennia. But then why are there virtually no reports of flying saucers prior to 1947? Why no warnings about the dangers of high technology then? Why isn't this genetic experiment, whatever its objective, completed by now -- thousands of years or more after its initiation by beings supposedly of vastly superior technological attainments?

Following this line of argument, we might anticipate present adherents of the old beliefs to understand "aliens" to be fairies, gods, or demons. In fact, there are several contemporary sects -- the "Raelians," for example -- that hold gods or God come to Earth in UFOs. And there are those who still think it's demons: Articles on UFOs in The Christian News Encyclopedia, a fundamentalist compilation, include "Unchristian Fanatic Obsession," and "Scientist Believes UFOs Work of Devil." The Spiritual Counterfeits Project of Berkeley, CA teaches that UFOs are of demonic origin; the Aquarian Church of Universal Service of McMinnville, OR, that all aliens are hostile. A 1993 newsletter of "Cosmic Awareness Communications" informs us that UFO occupants think of humans as laboratory animals, wish us to worship them, but tend to be deterred by the Lord's Prayer. A 1980 fundamentalist tract, The Cult Explosion, by Dave Hunt, reveals that

UFOs. . . are clearly not physical and seem to be demonic manifestations from another dimension calculated to alter man's way of thinking. . . . [T]he alleged UFO entities that have presumably communicated psychically with humans have always preached the same four lies that the serpent

introduced to Eve. . . . [T]hese beings are demons and they are preparing for the Antichrist."

A number of sects hold UFOs and alien abductions to be premonitions of "end-times."

→ The New Age: A Christian Critique by Ralph Rath (1990) discusses UFOs -- typically for such literature, with extreme credulity. It serves their purpose to accept UFOs as real and revile them as instruments of Satan and the Antichrist, rather than to use the blade of scientific skepticism. That tool, once honed, might accomplish more than just a limited heresiotomy. If UFOs come from another planet or another dimension, were they sent by the same God who has been revealed to us? Nothing in the UFO phenomena, the ^{Fundamentalist} complaint goes, requires belief in the one, true God, while much in it contradicts the God portrayed in the Bible and Christian tradition.

There is ^{also} a Christian tradition according to which extraterrestrial life cannot exist. In Christian News for May 23, 1994, for example, W. Gary Crampton, ^{Doctor of Theology.} ~~Th.D.~~ ^{why:} tells us ~~that~~

The Bible, either explicitly or implicitly, speaks to every area of life; it never leaves us without an answer. The Bible nowhere explicitly affirms or negates intelligent extraterrestrial life. Implicitly, however, Scripture does deny the existence of such beings, thus also negating the possibility of flying saucers. . . . Scripture views earth as the center of the universe. . . . According to Peter, a "planet hopping" Savior is out of the question. Here is an answer to intelligent life on other planets. If there were such, who would redeem them? Certainly not Christ. . . . Experiences which are out of line with the teachings of Scripture must always be renounced as fallacious. The Bible has a monopoly on the truth.

Other Christian sects -- Roman Catholics, for example -- have no

a priori objections to aliens and UFOs. Presumably, their judgment will depend on the evidence.

In the early 1960s, I argued (~~for example~~, in an article on "Flying Saucers" in the Encyclopedia Americana ^{and elsewhere}) that the UFO stories were crafted chiefly to satisfy religious longings. At a time when science has complicated uncritical adherence to the old-time religion^S, an alternative is proffered to the God hypothesis: Dressed in scientific jargon, their immense powers "explained" by superficially scientific terminology, the gods of old come down from heaven to haunt us, to offer prophetic visions, and to tantalize us with visions of a more hopeful future: a space-age mystery religion aborning.

The folklorist Thomas E. Bullard writes that

abduction reports sound like rewrites of older supernatural encounter traditions with aliens serving the functional roles of divine beings.

He concludes:

Science may have evicted ghosts and witches from our beliefs, but it just as quickly filled the vacancy with aliens having the same functions. Only the extraterrestrial outer trappings are new. All the fear and the psychological dramas for dealing with it seem simply to have found their way home again, where it is business as usual in the legend realm where things go bump in the night.

Is it possible that people in all times and places occasionally experience vivid, realistic hallucinations, often with sexual content, about abduction by strange creatures -- with the details filled in by the prevailing cultural idioms, sucked out of the Zeitgeist? Others, who have not personally had the

The connection ^{between the content of} spontaneous temporal lobe hallucinations and the alien abduction paradigm is consistent with such a hypothesis.

experience, find it stirring and in a way familiar. They pass the story on. Soon it takes on a life of its own, inspires others trying to understand their own visions and hallucinations, and enters the realm of folklore, myth, and legend.

Perhaps when everyone knows that gods come down to Earth, we hallucinate gods; when all of us are ~~is~~ familiar with demons, it's incubi and succubi; when fairies are widely accepted, we see fairies; in an age of spiritualism, we encounter spirits; and when the old myths fade and we begin thinking that extraterrestrial beings are plausible, then that's where our hypnogogic imagery tends. ^{events} ~~Snatches~~ of song or foreign languages, images, and ~~stories~~ ^{stories that we} that we witnessed ~~or~~ overheard in childhood can be accurately recalled decades later without any conscious memory of how they got into our heads. "[I]n violent fevers, men, all ignorance, have talked in ancient tongues," says Herman Melville in Moby Dick; "and. . . when the mystery is probed, it turns out always that in their wholly forgotten childhood those ancient tongues had been really spoken in their hearing." In our everyday life, we effortlessly and unconsciously incorporate cultural norms and make them our own.

A similar inhaling of motifs is present in schizophrenic "command hallucinations." Here people feel they are being told what to do by an imposing or mythic figure. They are ordered to assassinate a political leader or a folk hero, or harm themselves, because it is the wish of God, or Jesus, or the

devil, or demons, or angels, or -- lately -- aliens. The schizophrenic is transfixed by a clear and powerful command from a voice that no one else can hear, and must somehow identify. Who would issue such a command? Who could speak inside our heads? The culture in which we've been raised offers up an answer.

Think of the power of repetitive imagery in advertising, especially to suggestible viewers and readers. It can make us believe almost anything -- even that smoking cigarettes is cool. In our time, putative aliens are the subject of innumerable science fiction stories, novels, TV dramas, and films. UFOs are a regular feature of the weekly tabloids devoted to falsification and mystification. One of the highest-grossing motion pictures of all time is about aliens very like those described by abductees. Alien abduction accounts were comparatively rare until 1975, when a credulous television dramatization of the Hill~~l~~ case was aired; another leap into public prominence occurred after 1987, when a purported first-hand account with a haunting cover painting of a large-eyed "alien" became a best-seller. In contrast, we hear very little lately about incubi, elves, and fairies~~l~~. Where have they all gone?

Far from being global, such alien abduction stories are disappointingly local. The vast majority emanate from North America. They hardly transcend American culture. In other countries, bird-headed, insect-headed, reptilian, robot, and

blond and blue-eyed aliens are reported (the last, predictably, from northern Europe). Each group of aliens is said to behave differently. Clearly cultural factors are playing an important

role. *You can see it routinely in the science fiction of the '20s and '30s. And, for example, in an illustration of a Martian sending radio messages to Earth in the December 1937 issue of the magazine Short Wave and Television.*

Long before the terms "flying saucer" or "UFOs" were invented, science fiction was replete with "little green men" and "bug-eyed monsters." Somehow small hairless ^{beings} aliens with big heads (and eyes) have been ^{our staple aliens} ~~with us~~ for a long time. It goes back perhaps to the humans of the far future as depicted by the British science fiction pioneer, H. G. Wells. ~~Wells~~ Wells argued that humans evolved from smaller-brained but hairier primates with an athleticism far exceeding that of Victorian academics; extrapolating this trend into the far future, he suggested that our descendants should be nearly hairless, with immense heads, although barely able to walk around on their own. Advanced beings from other worlds might be similarly endowed.

The typical modern extraterrestrial reported in America in the '80s and early '90s is small, with disproportionately large head and eyes, undeveloped facial features, no visible eyebrows or genitals, and smooth gray skin. It looks to me eerily like a fetus in roughly the twelfth week of pregnancy, or a starving child. Why so many of us might be obsessing on fetuses or malnourished children, and imagining them attacking and sexually manipulating us, is an interesting question.

In recent years in America, aliens different from the short gray motif have been on the rise. One psychotherapist, Richard Boylan of Sacramento, says:

You've got three-and-a-half foot to four-foot types; you've got five- to six-foot types; you've got seven- to eight-foot types; you've got three-, four-, and five-finger types, pads on the ends of fingers or suction cups; you've got webbed or non-webbed fingers; you've got large almond-shape eyes slanted upward, outward, or horizontally; in some cases large ovoid eyes without the almond slant; you've got extraterrestrials with slit pupils; you've got other different body types -- the so-called Praying Mantis type, the reptoid types. . . These are the ones that I keep getting recurrently. There are a few exotic and single case reports that I tend to be a little cautious about until I get a lot more corroborative.

Despite this apparent variety of extraterrestrials, the UFO abduction syndrome portrays, it seems to me, a banal Universe. The supposed aliens are marked by a failure of the imagination and a preoccupation with human concerns. ^{Not a single} ~~No~~ being presented in all these accounts is as astonishing as a cockatoo would be if you had never ^{before} beheld a bird. Any protozoology or bacteriology or mycology textbook is filled with wonders that far outshine the most exotic descriptions of the alien abductionists. The believers take the common elements in their stories as tokens of verisimilitude, rather than as evidence that they have contrived their stories out of a shared culture and biology.

Beginning around the time of the television movie portraying the Hills' case, reports of flying saucers haunting the skies of Earth have diminished. These days, ^{even} ~~and not~~ counting crop pictograms, it's down to a comparative trickle. Instead the

passion, the emotional energy, the conspiratorial hypotheses are mainly invested in reports of direct encounters with alien beings. In a way the new stories are much less enigmatic than the old. After all, a light in the sky might be anything. But mute, gray, telepathic aliens crowding into your bedroom. . .?

[M, 11/28/94]

Chapter 8

THERAPY

It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.

-- Sherlock Holmes, in Arthur Conan Doyle's A Scandal in Bohemia ~~{date}~~ (July 1891).

For just an instant I sense an apparition -- could it be a ghost? -- in the darkened room. Or there's a flicker of motion; I see it out of the corner of my eye, but when I turn ^{my head} there's nothing there. Is that a telephone ringing, or is it just my "imagination"? In astonishment, I seem to be smelling the salt air of the Coney Island summer seashore of my childhood. I turn a corner in the foreign city I'm visiting for the first time, and before me is a street so familiar I feel I've known it all my life.

In these commonplace experiences, we're generally unsure what to do next. Were my eyes (or ears, or nose, or memory) playing "tricks" on me? Or did I, really and truly, witness something out of the ordinary course of Nature? Shall I keep quiet about it, or shall I tell?

The answer depends very much on my environment, friends, loved ones, and culture. In an obsessively rigid, practically oriented society, perhaps I would be cautious about admitting to such experiences. In a society that readily believes in ghosts, say, or "apporting," accounts of such experiences might gain

approval, even prestige. In the former, I would be sorely tempted to suppress the thing altogether; in the latter, maybe even to exaggerate or elaborate just a little to make it even more miraculous than it seemed.

Charles Dickens, who lived in a flourishing rational culture in which, however, spiritualism was also thriving, described the dilemma in these words (from his short story, "To Be Taken with a Grain of Salt"):

I have always noticed a prevalent want of courage, even among persons of superior intelligence and culture, as to imparting their own psychological experiences when those have been of a strange sort. Almost all men are afraid that what they could relate in such wise would find no parallel or response in a listener's internal life, and might be suspected or laughed at. A truthful traveller who should have seen some extraordinary creature in the likeness of a sea-serpent, would have no fear of mentioning it; but the same traveller having had some singular presentiment, impulse, vagary of thought, vision (so-called), dream, or other remarkable mental impression, would hesitate considerably before he would own to it. To this reticence I attribute much of the obscurity in which such subjects are involved.

In our time, there is still much dismissive chortling and ridicule. But the reticence and obscurity is more readily overcome -- for example, in a "supportive" setting, provided by a therapist or hypnotist. Unfortunately -- and, for some people, unbelievably -- the distinction between imagination and memory is often blurred.

Some "abductees" say they remember the experience without hypnosis; most do not. But hypnosis is an unreliable way to refresh memory. It often elicits imagination, fantasy, and play

as well as true recollections, with neither patient nor therapist able to distinguish the one from the other. Hypnosis seems to involve, in a central way, a state of heightened suggestibility. Courts have banned its use as evidence or even as a tool of criminal investigation. The American Medical Association calls memories surfacing under hypnosis less reliable than those recalled without it. So the fact that, when hypnotized, people sometimes relate alien abduction stories carries little weight. Indeed, there's a danger that subjects are -- at least on some matters -- so eager to please the hypnotist that they sometimes respond to subtle cues of which even the hypnotist is unaware.

In a study by Alvin Lawson of California State University, Long Beach, eight subjects, pre-screened to eliminate UFO buffs, were hypnotized by a physician and informed that they had been abducted, brought to a spaceship, and examined. With no further prompting, they were asked to describe the experience. Their accounts -- most of which were easily elicited -- were almost indistinguishable from the accounts that self-described abductees present. True, Lawson had cued his subjects briefly and directly; but in many cases the therapists who routinely deal with alien abductions cue their subjects -- some in great detail, others more subtly and indirectly.

The University of Washington psychologist Elizabeth Loftus has found that subjects can easily be made to believe they saw something they didn't. In a typical experiment, subjects will

President Ronald Reagan, who spent his World War ^{II} days in Hollywood, vividly described his role in liberating concentration camp victims. Living in the film world, he apparently confused a movie he had seen with a reality he had not.

["Therapy" (M, 11/28/94)]

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view a film of a car accident. In the course of being questioned about what they saw, they're casually given false information. For example, a stop sign is off-handedly referred to, although there wasn't one in the film. Many subjects then dutifully recall seeing a stop sign. When the deception is revealed, some vehemently disagree, stressing how vividly they remember the sign. The greater the time lag between viewing the film and being given the false information, the more people allow their memories be tampered with. Loftus argues that "memories of an event more closely resemble a story undergoing constant revision than a packet of pristine information."

There are many other examples, some -- a spurious memory of being lost as a child in a shopping mall, for instance -- of greater emotional impact. Once the key idea is implanted, the patient often plausibly fleshes out the supporting details. Lucid but wholly false recollections can easily be induced by a few cues and questions, especially in the therapeutic setting. Memory can be contaminated. False memories can be implanted even in minds that do not consider themselves vulnerable and uncritical.

Stephen Ceci of Cornell University, Loftus, and their colleagues have found unsurprisingly that preschoolers are exceptionally vulnerable to suggestion. The child who correctly denies having caught his hand in a mousetrap when first asked later remembers the event in vivid, self-generated detail. When

more directly told about "some things that happened to you when you were little," over time they easily enough assented to the implanted memories. Professionals watching videotapes of the children could do no better than chance in distinguishing false memories from true ones. Is there any reason to think that adults are wholly immune to the fallibilities exhibited by children?

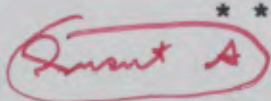
Many other instances of this sort ^{can} be found in his pub statements

In preparing for courtroom testimony, witnesses are coached by their lawyers. Often, they are made to repeat the story over and over again, until they get it "right." Then, on the stand what they remember is the story they've been telling in the lawyer's office. The nuances have been shaded. Or it may no longer correspond, even in its major features, with what really happened. Conveniently, they may have forgotten that their memories were reprocessed.

These facts are relevant in evaluating the societal effects of advertising and of national propaganda. But here they suggest that on alien abduction matters -- where interviews typically take place years after the alleged event -- therapists must be very careful that they do not accidentally implant or select the stories they elicit.

Perhaps what we actually remember is a set of memory fragments stitched onto a fabric of our own devising. If we sew cleverly enough, we have made ourselves a memorable story easy ~~for us~~ to recall. Fragments by themselves, unencumbered by

associations, are harder to retrieve. The situation is rather like the method of science itself -- where many isolated data points can be remembered, summarized, and explained in the framework of a theory. We then tend to remember the theory and not the data. In science the theories are always being reassessed ^{and} confronted with new facts; if the facts are seriously discordant, the theory may have to be revised. But in everyday life it is very rare that we are confronted with new facts about events of long ago. Our memories are almost never challenged. They can, instead, be frozen in place, no matter how flawed they are, or become a work in continual artistic revision.

* * *


Why would people invent abduction stories? Discovering that you're an alien abductee is at least a break from the routine of everyday life. You gain the attention of peers, therapists, maybe even the media. There is a sense of discovery. What will you remember next? You begin to believe that you may be the harbinger or even the instrument of momentous events now rolling towards us. And you don't want to disappoint your therapist. You crave his or her approval. I think there can very well be psychic rewards in becoming an abductee.

Consider product tampering cases, which convey very little of the sense of wonder that surrounds UFOs and alien abductions:

Insert A into The Demon-Haunted World, Chapter ⁸ 7, p. ⁶ 7, just
~~after the stars; derived from \12-11-94.at1; saved as~~
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Among all the gods and demons, the best-attested apparitions are those of saints -- especially the Virgin Mary in Western Europe from late medieval to modern times. While alien abduction stories have much more the flavor of profane apparitions, insight into the UFO myth can also be gained from sacred visions. Perhaps best-known are those of Joan of Arc in France, St. Bridget in Sweden, and Girolamo Savonarola in Italy. But more appropriate for our purpose are the apparitions seen by shepherds and peasants and children. In a world plagued by uncertainty and horror, these people longed for contact with the divine. A detailed record of such events in Castille and Catalonia is provided by William A. Christian, Jr. in his book Apparitions in Late Medieval and Renaissance Spain (Princeton University Press, 1981):

In a typical case, a rural woman or child reports encountering a girl or an oddly tiny woman who reveals herself to be the Virgin Mary, the Mother of God. She commands the awestruck witness to go to the village fathers or the Church authorities and order them to say prayers for the dead, or obey the Commandments, or build a shrine at this very spot in the countryside. If they do not comply, dire penalties ^{are threatened,} ~~will ensue~~, perhaps the plague. Alternatively, in plague-infested times, Mary promises cure of disease if her request is satisfied.

The witness tries to do as she is told. But when she informs her father or husband or priest, she is ordered to ^{repeat the story to} ~~tell~~ no one; ^{it} ~~this~~ is mere foolishness or frivolity or ~~a~~ demonic hallucination. So she keeps quiet. Days later she is confronted again by Mary, ^{a little} ~~who is~~ put out that her request has not been honored.

"They will not believe me," the witness complains. "Give me a sign."

So Mary provides a sign. The villagers and priests are convinced. The shrine is built. Miraculous cures occur in its vicinity. Pilgrims come from far and wide. Priests are busy. The economy of the region booms. The original witness is appointed keeper of the sacred shrine.

In most of the cases we know [&] ~~about~~ there was a commission of inquiry, including civic and ecclesiastical leaders, who attested to the genuineness of the apparition -- despite initial, almost exclusively male, skepticism. But the standards of evidence were not generally high. In one case the testimony of a delirious eight-year-old boy, taken two days before his death from plague, was ^{soberly} ~~considered significant~~. Some of these commissions deliberated decades or even a century after the event.

In On the Distinction Between True and False Visions, an expert on the subject, Jean Gerson, around 1400, summarized the criteria for recognizing a credible witness to an apparition: One was the willingness to accept advice from those in authority.

Thus anyone who saw a vision ~~disquieting~~^{turbid} to those in power was ipso facto an unreliable witness, and saints and virgins could be made to say only what the authorities wanted to hear.

The "signs" allegedly provided by Mary, the evidence offered and considered compelling, included an ordinary candle, a piece of silk, and a magnetic stone; a piece of colored tile; footprints; the witness's unusually quick gathering of thistles; a simple wooden cross inserted in the ground; welts and wounds on the witness; and a variety of contortions -- a 12-year-old with her hand held funny, or legs folded back, or a closed mouth making the witness temporarily mute -- that are "cured" the moment her story is accepted.

In some cases ~~stories~~^{accounts} had clearly been compared and coordinated before testimony was given. For example, multiple witnesses might tell of a tall, glowing woman dressed all in white carrying an infant son and surrounded by a radiance that lit up the street. But in other cases people standing directly beside the witness could see nothing, as in this report of a 1617 apparition from Castile:

'Ay, Bartolomé, the lady who came to me these past days is coming through the meadow, and she is kneeling and embracing the cross there -- look at her, look at her!' The youth though he looked as hard as he could saw nothing except some small birds flying around above the cross.

Possible motives for inventing such stories are not hard to find: jobs for priests, notaries, carpenters⁵ and merchants, and other boosts to the regional economy in a time of depression;

augmented social status of the witness and her family; prayers ^{offered} again, for relatives buried in graveyards ^{later} abandoned because of plague, drought, and war; rousing public spirit against enemies, especially Moors; improving civility and obedience to canon law; and confirming the faith of the pious. The fervor of pilgrims in such shrines was impressive; it was not uncommon for rock scrapings or dirt from the shrine to be mixed with water and drunk as medicine. ^{But I'm not suggesting that most witnesses made the whole business up. Something else was going on.}

Almost all the urgent requests by Mary were remarkable for their prosaicness -- for example, in this 1483 apparition from Catalonia:

I charge you by your soul to charge the souls of the men of the parishes of El Torn, Milleras, El Salent, and Sant Miquel de Campmaior to charge the souls of the priests to ask the people to pay up the tithes and all the duties of the church and restore other things that they hold covertly or openly which are not theirs to their rightful owners within thirty days, for it will be necessary, and observe well the holy Sunday.

And second that they should cease and desist from blaspheming and they should pay the usual charitats mandated by their dead ancestors.

Often the apparition is seen just after the witness awakes. Francisca la Brava testified in 1523 that she had gotten out of bed "without knowing if she was in control of her senses," although in later testimony she claimed to be fully awake. (This was in response to a question which allowed ~~that~~ a gradation of possibilities: fully awake, dozing, in a trance, asleep.) Sometimes details are wholly missing, such as what the accompanying angels looked like; or Mary is described as both

tall and short, both mother and child -- characteristics that unmistakably suggest themselves as dream material. In the dialogue on miracles written around 1223 by Caesarius of Heisterbach, clerical visions of the Virgin Mary often occurred during matins, which took place at the sleepy midnight hour.

It is natural to suspect that many, perhaps all, of these apparitions were a species of dream, waking or ~~asleep~~^{ing}, compounded by hoaxes (and by forgeries; there was a thriving business in contrived miracles: religious paintings and statues dug up by accident or divine command). The matter was addressed in the Siete Partidas, the codex of canon and civil law compiled under the direction of Alfonso the Wise, king of Castille, around 1248. In it we can read the following:

Some men fraudulently discover or build altars in fields or in towns, saying that there are relics of certain saints in those places and pretending that they perform miracles, and, for this reason, people from many places are induced to go there as on a pilgrimage, in order to take something away from them; and there are others who influenced by dreams or empty phantoms which appear to them, erect altars and pretend to discover them in the above named localities.

In listing the reason for erroneous beliefs, Alfonso lays out a continuum from sect, opinion, fantasy, and dream to hallucination. A kind of fantasy named antoiança is defined as follows:

Antoiança is something that stops before the eyes and then disappears, as one sees or hears it in a trance, and so is without substance.

A 1517 papal bull distinguishes between apparitions that appear "in dreams or divinely." Clearly, the secular and ecclesiastical

authorities, even in times of extreme credulity, were alert to the possibilities of hoax and delusion.

Nevertheless, in most of medieval Europe, such apparitions were greeted warmly by the Roman Catholic clergy -- especially because the Marian admonitions were so congenial to the priesthood. A pathetic few "signs" of evidence -- a stone or a footprint and never anything unfakeable -- sufficed. But beginning in the fifteenth century, around the time of the Protestant Reformation, the attitude of the Church changed. Those who reported an independent channel to Heaven were outflanking the Church's chain of command up to God. Moreover, a few of the apparitions -- Jeanne d'Arc's, for example -- had awkward political or moral implications. The perils represented by Jeanne d'Arc's visions were described by her inquisitors in 1431 in these words:

The great danger was shown to her that comes of someone so presumptuous to believe they have such apparitions and revelations, and therefore lie about matters concerning God, giving out false prophecies and divinations not known from God, but invented. From which could follow the seduction of peoples, the inception of new sects, and many other impieties that subvert the Church and Catholics.

Both Jeanne d'Arc and Girolamo Savonarola were burnt at the stake for their visions.

In 1516 the Fifth Lateran Council reserved to "the Apostolic seat" the right to examine the authenticity of apparitions. For poor peasants whose visions had no political content, the punishments were less severe. The apparition of Francisca la

Brava, a young mother, was described by Licenciado Mariana, the Lord Inquisitor, as "to the detriment of our holy Catholic faith and the diminution of its authority." Her apparition "was all vanity and frivolity." "By rights we could have treated her more rigorously," the Inquisitor continued.

But in deference to certain just reasons that move us to mitigate the rigor of the sentences we decree as a punishment to Francisca la Brava and an example to others not to attempt similar things that we condemn her to be put on an ass and given one hundred lashes in public through the accustomed streets of Belmonte naked from the waist up, and the same number in the town of El Quintanar in the same manner. And that from now on she not say or affirm in public or secretly by word or insinuation the things she said in her confessions or else she will be prosecuted as an impenitent and one who does not believe in or agree with what is in our holy Catholic faith.

Despite the severity of the penalties, it is striking how often the witness stuck to her guns, and ^{ignoring} ~~despite all~~ the encouragements provided to confess that she was lying or dreaming or confused, ~~she~~ insisted that she really and truly had seen the apparition. *when nearly everyone was illiterate,*

In a time [^] before newspapers, radio, and television, how could the religious and iconographic detail of these apparitions have been so similar? William Christian believes there is a ready answer in cathedral dramaturgy (especially Christmas plays), in itinerant preachers and pilgrims, and in church sermons. Legends about nearby shrines spread quickly, ~~because~~ ^P people sometimes came from a hundred miles or more so that, say, their sick child could be cured by a pebble that had been trodden on by the Mother of God. Legends influenced apparitions and vice

versa. In a time haunted by drought, plague, and war, with no social or medical services available to the average person, the threshold ~~of skepticism was very low.~~ *at which skeptical thinking is triggered was very high.*

The content of the apparitional message and its target both strongly suggest ~~other than divine~~ *a mundane* origin. Why are the admonitions so prosaic? Why is an apparition of so illustrious a personage as the Mother of God necessary so, in a tiny county populated by a few thousand souls, a shrine will be repaired or the populace will refrain from cursing? Why not important and prophetic messages whose significance could be recognized in later years as something that could have emanated only from God or the saints? Wouldn't this have greatly enhanced the Catholic cause in its mortal struggle with Protestantism *and the Enlightenment?* But we have no apparitions cautioning the Church against accepting the delusion of an Earth-centered Universe, or warning it of complicity with Nazi Germany -- two matters of considerable moral as well as historical import, on which Pope John Paul II, to his credit, has admitted that the Church has erred. ~~And~~ *Why* is Mary always telling the poor peasant to inform the authorities? Why doesn't *she admonish* ~~Mary appear to~~ the authorities directly? Or the king? Or the Pope? In the nineteenth and twentieth centuries, it is true, some of the apparitions have taken on greater import -- at Fatima, Portugal in 1917, where the Virgin was incensed that a secular government had replaced one run by the Church, and at Garabandal, Spain in 1961-1965, where the end of the world was

threatened unless conservative political and religious doctrines were adopted forthwith.

I think I can see many parallels between Marian apparitions and alien abductions -- even though the witnesses in the former cases are not promptly taken to Heaven and don't have their reproductive organs meddled with. The beings reported are diminutive, about two-and-a-half to four feet high. The content of the communication is, despite its purported celestial origin, mundane. There seems to be a clear connection with sleep and dreams. The witnesses are troubled about speaking out, especially after encountering ridicule from males in positions of authority. Nevertheless they persist: They really saw such a thing, they insist. Means of conveying the stories exist; they are eagerly discussed, permitting details to be coordinated even among witnesses who have never met one another. ~~Potential~~ *Others* ~~witnesses~~ present at the time and place of the apparition see nothing unusual. ~~And~~ *The* purported "signs" or evidence are, *without exception,* nothing that humans couldn't acquire or fabricate on their own. *Indeed,* Mary seems unsympathetic to the need for evidence, and occasionally *is willing to* ~~would~~ cure only those who had believed the account of her apparition before she supplied "signs."¹

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And while there are no therapists, per se, the society is suffused by a network of ^{parish} priests and their hierarchical superiors who have a vested interest in the reality of the apparitions.

There are many reasons why the government should not be involved in the private sector.

First, the government should not be involved in the private sector because it is not its business.

Second, the government should not be involved in the private sector because it is not its responsibility.

Third, the government should not be involved in the private sector because it is not its duty.

Fourth, the government should not be involved in the private sector because it is not its right.

Fifth, the government should not be involved in the private sector because it is not its power.

Sixth, the government should not be involved in the private sector because it is not its authority.

Seventh, the government should not be involved in the private sector because it is not its jurisdiction.

Eighth, the government should not be involved in the private sector because it is not its competence.

Ninth, the government should not be involved in the private sector because it is not its expertise.

Tenth, the government should not be involved in the private sector because it is not its skill.

Eleventh, the government should not be involved in the private sector because it is not its talent.

Twelfth, the government should not be involved in the private sector because it is not its ability.

lie
ts.

Someone claims to find a hypodermic syringe in a popular soft drink can. Understandably, this is upsetting. It's reported in newspapers and especially on television news. Soon there's a spate, a virtual epidemic of similar reports from all over the country. But it's very hard to see how a hypodermic syringe could get into a can at the factory, and in none of the cases are witnesses present when an intact can is opened and a syringe discovered inside.

Slowly the evidence accumulates that this is a "copycat" crime. People have only been pretending to find syringes in soft drink cans. Why would anyone do it? What possible motive could they have? Psychiatrists expert in such matters say that the primary motives are greed (they'll sue the manufacturer for damages), a craving for attention, and a wish to be portrayed as a victim. Note there are no therapists touting the reality of needles in cans and urging their patients -- subtly or directly -- to go public with the news. Also, serious penalties are levied for product tampering, and even for falsely alleging that products have been tampered with. In contrast, there are *to tell their stories to mass audiences,* therapists who encourage abductees, and no legal penalties are exacted for falsely claiming you've been abducted by a UFO. Whatever your reason for going down this road, how much more satisfying it must be to convince others that you've been chosen by extraterrestrial beings for their own enigmatic purpose than that by mere happenstance you've found a hypodermic syringe in

your cola. There are motives.

John Mack is a Harvard University psychiatrist whom I've known for many years.

Is there anything to this UFO business? he asked me long ago.

Not much, I replied. Except of course on the psychiatric side.

He looked into it, interviewed abductees, and was converted. He now accepts the accounts of abductees at face value. Why?

"I wasn't looking for this," he says. "There's nothing in my background that prepared me" for the alien abduction story.

"It's completely persuasive because of the emotional power of these experiences."

I can personally attest to the emotional power. But aren't powerful emotions a routine component of our dreams? Don't we sometimes wake in stark terror? Have the hypnotists and psychotherapists working with "abductees" made conscientious attempts to steep themselves in the body of knowledge on ~~human~~ hallucinations and perceptual malfunctions? Why do they believe these witnesses but not those who reported, with comparable conviction, encounters with gods, demons, ^{saints,} angels, and fairies? And what about those who hear irresistible commands from a voice within? Are all deeply felt stories true?

A scientist of my acquaintance says "If the aliens would only keep all the folks they abduct, our world would be a little

saner." But her judgment is too harsh. It doesn't seem to be a matter of sanity. It's something else. The Canadian psychologist Nicholas Spanos and his colleagues concluded that there are no obvious pathologies in those who report being abducted by UFOs. However,

intense UFO experiences are more likely to occur in individuals who are disposed to esoteric beliefs in general and alien beliefs in particular and who interpret unusual sensory and imaginal experiences in terms of the alien hypothesis. Among UFO believers, those with stronger propensities toward fantasy production were particularly likely to generate such experiences. Moreover, such experiences were likely to be generated and interpreted as real events rather than imaginings when they were associated with restricted sensory environments. . . (e.g., experiences that occurred at night and in association with sleep).

What a more critical mind might recognize as a hallucination or a dream, a more credulous mind interprets as ~~a special gift granting~~ ^{but profound} a glimpse of an elusive external reality.

* * *

Some alien abduction accounts may conceivably be disguised or screen memories of rape and childhood sexual abuse, with the father, stepfather, brother, or mother's boyfriend represented as an alien. Surely it's more comforting to believe that an alien abused you than that it was done by someone you trusted and loved. Therapists who take the alien abduction stories at face value deny this, saying they would know if their patients were sexually abused. But typical estimates from opinion surveys are

that one in four American women and one in six American men were sexually abused in childhood. It would be astonishing if a significant number of patients who present themselves to alien abduction therapists had not been so abused, perhaps even a larger proportion than in the general population. Both sexual abuse and alien abduction therapists spend months, sometimes years, encouraging their subjects to remember being abused. Their methods are similar, and their goals in a way the same -- to recover painful memories, often of long ago. In both cases the therapist believes the patient to be suffering from trauma attendant to an event so terrible that it is repressed. I find it striking that alien abduction therapists find so few cases of sexual abuse, and vice versa.

Those who have in fact been subjected to childhood sexual abuse or incest are, for very understandable reasons, sensitive about anything that seems to minimize or deny their experience. They are angry, and they have every right to be. In the U.S., at least 12 million women have been raped, almost two-thirds before the age of eighteen. A recent survey reports that one-sixth of all rape victims reported to police are under the age of 12. (And this is the category of rape least likely to be reported.) One-fifth of these girls were raped by their fathers. They have been betrayed. I want to be very clear about this: There are many real cases of ghoulish sexual predation by parents, or those acting in the role of parents. Compelling physical evidence --

photos, for example, or diaries, or gonorrhea or chlamydia in the child -- have in some cases come to light. Abuse of children has been implicated as a major cause of social problems. Eighty-five percent of all violent prison inmates were abused in childhood. Two-thirds of all teenage mothers were raped or sexually abused as children or teenagers. Rape victims are ten times more likely to abuse alcohol and other drugs. The problem is real and urgent. Most of these tragic and incontestable cases of childhood sexual abuse, however, have been continuously remembered into adulthood.

While there is better reporting today than in the past, there does seem to be a significant increase in cases of child abuse reported each year by hospitals and law enforcement authorities, rising in the United States ten-fold (to 1.7 million cases) between 1967 and 1985. Alcohol and other drugs, as well as economic stresses, are pointed to as the "reasons" adults are more prone to abuse children today than in the past. Perhaps increasing publicity given to contemporary cases of child abuse emboldens adults to remember and focus on the abuse they once suffered.

A century ago, Sigmund Freud introduced the concept of repression, the forgetting of events in order to avoid intense psychic pain, a coping mechanism essential for mental health. Nevertheless, cases in which the "memory" suddenly surfaces, especially at the ministrations of a psychotherapist or

hypnotist, and where the first "recollections" have a ghost- or dreamlike quality are questionable. Many such claims of sexual abuse appear to be invented. The Emory University psychologist Ulric Neisser says:

There is child abuse, and there are such things as repressed memories. But there are also such things as false memories and confabulations, and they are not rare at all. Misrememberings are the rule, not the exception. They occur all the time. They occur even in cases where the subject is absolutely confident -- even when the memory is a seemingly unforgettable flashbulb, one of those metaphorical mental photographs. They are still more likely to occur in cases where suggestion is a lively possibility, where memories can be shaped and re-shaped to meet the strong interpersonal demands of a therapy session. And once a memory has been reconfigured in this way, it is very, very hard to change.

These general principles cannot help us to decide with certainty where the truth lies in any individual case or claim. But on the average, across a large number of such claims, it is pretty obvious where we should place our bets. Misremembering and retrospective reworking of the past are a part of human nature; they go with the territory and they happen all the time.

Survivors of the Nazi death camps provide the clearest imaginable demonstration that even the most monstrous abuse can be carried continuously in human memory. Indeed, the problem for many Holocaust survivors has been to put some emotional distance between themselves and the death camps, to forget. But if in some world of inexpressible evil they were forced to live in Nazi Germany -- let's say a thriving post-Hitler nation with its ideology intact, except ^{that it's} ~~it has~~ changed its mind about anti-Semitism -- imagine the psychological burden on Holocaust survivors then. Then perhaps they would be able to forget, because remembering would make their current lives unbearable.

In the same way, remembering childhood sexual abuse while living with and hoping to maintain a normal relationship with the adult abuser is asking too much. If there is such a thing as the repression and subsequent recall of ghastly memories, then perhaps it requires two conditions: (1) that the abuse actually happened, and (2) that the victim was required to pretend for long periods of time that it never happened.

The Berkeley sociologist Richard Ofshe explains:

When patients are asked to explain how the memories returned, they report assembling fragments of images, ideas, feelings, and sensations into marginally coherent stories. As the so-called memory work stretches out for months, feelings become vague images, images become figures, and figures become known persons. Vague discomfort in certain parts of the body is reinterpreted as childhood rape. . . . The original physical sensations, sometimes augmented by hypnosis, are then labeled "body memories." There is no conceivable mechanism by which the muscles of the body could store memories. If these methods fail to persuade, the therapist may resort to still more heavy-handed practices. Some patients are recruited into survivor groups in which peer pressure is brought to bear, and they are asked to demonstrate politically correct solidarity by establishing themselves as members of a survivor subculture.

A cautious 1993 statement by the American Psychiatric Association accepts the possibility that some of us forget childhood abuse as a means of coping, but warns,

It is not known how to distinguish, with complete accuracy, memories based on true events from those derived from other sources. . . . Repeated questioning may lead individuals to report "memories" of events that never occurred. It is not known what proportion of adults who report memories of sexual abuse were actually abused. . . . A strong prior belief by the psychiatrist that sexual abuse, or other factors, are or are not the cause of the patient's problems is likely to interfere with appropriate assessment and treatment.

On the one hand, callously to dismiss charges of horrifying sexual abuse and to return the children to the mercies of the abuser is heartless injustice. On the other hand, to tamper with people's memories, to infuse false stories of childhood abuse, to break up intact families, and even to send innocent parents to prison is also heartless injustice. Picking our way between these two extremes can be very tricky. Because we're mammals, we have built-in machinery to care for the young; and when given a choice between two such unpleasant alternatives, many of us naturally lean towards protecting children, even at the risk of unfairly punishing adults.

Early editions of the influential book by Ellen Bass and Laura Davis [The Courage to Heal: A Guide for Women Survivors of Child Sexual Abuse] give illuminating advice to therapists:

Believe the survivor. You must believe your client was sexually abused, even if she doubts it herself. . . Your client needs you to stay steady in the belief that she was abused. Joining a client in doubt would be like joining a suicidal client in her belief that suicide is the best way out. If a client is unsure that she was abused but thinks she might have been, work as though she was. So far, among the hundreds of women we've talked to and the hundreds more we've heard about, not one has suspected that she might have been abused, explored it, and determined that she wasn't.

Kenneth V. Lanning, a leading FBI expert on the sexual victimization of children, wonders: "Are we making up for centuries of denial by now blindly accepting any allegation of child abuse, no matter how absurd or unlikely?"

The existence of any false accusation of childhood sexual abuse has, it seems to me, relevance to the alien abduction

issue. As I've mentioned, alien abduction might be a way-station to remembering childhood abuse. But also, if some people can with great passion and conviction falsely remember being abused by their own parents, might not others, with comparable passion and conviction, falsely remember being abused by aliens?

The more I look into claims of alien abduction, the more similar they seem to spurious reports of childhood sexual abuse. And there's a third class of related claims, repressed "memories" of satanic ritual cults -- in which sexual torture, coprophilia,^{infanticide,} and cannibalism^{said to be} are prominently featured. A significant number of those touting rampant satanism in America, including some law enforcement officers, turn out to be Christian fundamentalists; their religion explicitly requires a literal devil to be meddling in everyday human life. The connection is neatly drawn in the saying "No Satan, no God." But this is unlikely to be the whole story: In a survey of 2,700 members of the American Psychological Association, 30 percent replied that they had treated cases of ritual abuse.

Many of those alleging satanic abuse describe grotesque orgiastic rituals in which infants are murdered and eaten. The absence of lost infants in police and missing persons files is explained by the claim that all over the world babies are being bred for this purpose -- surely reminiscent of abductee claims that alien/human breeding experiments are rampant. Also similar to the alien abduction paradigm, satanic cult abuse is said to

pass down from generation to generation in certain families. To the best of my knowledge, as in the alien abduction paradigm, no physical evidence has ever been offered in a court of law to support such claims. Their emotional power, though, is evident. The mere possibility that such things are going on rouses us mammals to action. When we give credence to satanic ritual, we also raise the social status of those who warn us of the supposed danger.

Certainly there are documented contemporary examples of horrendous abuse connected with religion. Myra Obasi, a Louisiana schoolteacher, was -- she and her sisters believed after consultation with a hoodoo practitioner -- possessed by demons. Her nephew's nightmares were part of the evidence. So they left for Dallas, abandoned their five children, and the sisters ^{then} gouged out Ms. Obasi's eyes. At the trial, ^{she} ~~the victim~~ defended her sisters. They were trying to help her, she said. But hoodoo is not devil-worship; it is a cross between Catholicism and African-Haitian nativist religion. A 14-year-old boy had his eyeball plucked out of his head in an exorcism ceremony. But his assailant was not a satanist, but a Protestant fundamentalist minister engaged in religious pursuits. A woman thought her 12-year-old son was possessed by the devil. After an incestuous relationship with him, she decapitated him. But there was no satanic ritual content.

These last two cases come from a 1994 study by Dr. Gail Goodman, a psychologist at the University of California, Davis, and her colleagues, done for the National Center on Child Abuse and Neglect. They examined over 12,000 claims of sexual abuse involving satanic ritual cults, and could not find a single one that held up to scrutiny. Therapists reported satanic abuse based only on, for instance, "patient's disclosure via hypnotherapy" or children's "fear of satanic symbols." In some cases diagnosis was made on the basis of behavior common to many children. "In only a few cases was physical evidence mentioned -- usually, 'scars.'" But in most cases the "scars" were very faint or nonexistent. "Even when there were scars, it was not determined whether the victims themselves had caused them." This also is very similar to alien abduction cases, as described below.

The existence of a highly skeptical FBI report on the subject [Kenneth V. Lanning, "Investigator's Guide to Allegations of 'Ritual' Child Abuse," January 1992] is widely ignored by enthusiasts. Likewise, a 1994 study by the British Department of Health into claims of satanic abuse there concluded that, of 84 alleged instances, not one stood up to scrutiny. What then is all the furor about? The report explains,

The Evangelical Christian campaign against new religious movements has been a powerful influence encouraging the identification of satanic abuse. Equally, if not more, important in spreading the idea of satanic abuse in Britain are the "specialists," American and British. They may have few or even no qualifications as professionals, but

attribute their expertise to "experience of cases."

Those convinced that devil cults represent a serious danger to our society tend to be impatient with skeptics. Consider this analysis by Corydon Hammond, Ph.D., past President of the American Society for Clinical Hypnosis:

[multiple personality disorders]

I will suggest to you that these people [skeptics] are either, one, naive and of limited clinical experience; two, have a kind of naiveté that people have of the Holocaust, or they're just such intellectualizers and skeptics that they'll doubt everything; or, three, they're cult people themselves. And I can assure that there are people who are in that position. . . There are people who are physicians, who are mental health professionals, who are in the cults, who are raising trans-generational cults. . . I think the research is real clear: We got three studies, one found 25 percent, one found 20 percent of out-patient multiples appear to be cult-abuse victims, and another on a specialized in-patient unit found 50 percent.

In all three classes of "recovered memories," there are specialists -- alien abduction specialists, satanic cult specialists, and specialists in recalling suppressed memories of childhood sexual abuse. As is common in medical practice, patients select ^{or are referred to} a therapist whose specialty seems relevant to their complaint. In all three classes, the therapist helps to elicit recollections of long ago (in some cases from decades past); in all three, therapists are profoundly moved by the unmistakable genuine agony of their patients; in all three, at least some therapists are known to ask leading questions -- which are virtually orders by authority figures to suggestible patients insisting that they remember (I almost wrote "confess"); in all three, there are networks of therapists who trade patient

histories and therapeutic methods; in all three, practitioners feel the necessity of defending their practice against more skeptical colleagues; in all three, the iatrogenic hypothesis is given short shrift; in all three, the majority of those who report abuse are women. And in all three classes -- with the exceptions mentioned -- there is no physical evidence. So it's hard not to wonder whether alien abductions might be part of some larger picture.

What could this larger picture be? I posed this question to Fred H. Frankel, professor of psychiatry at Harvard Medical School, Chief of Psychiatry at Beth Israel Hospital in Boston, and a leading expert on hypnosis. His answer:

If alien abductions are a part of a larger picture, what indeed is the larger picture? I fear to rush in where angels fear to tread; however, the factors you outline all feed what was described at the turn of the century as "hysteria." The term, sadly, became so widely used that our contemporaries in their dubious wisdom. . . not only dropped it, but also lost sight of the phenomena it represented: high levels of suggestibility, imaginal capacity, sensitivity to contextual cues and expectations, and the element of contagion. . . Little of all of this seems to be appreciated by a large number of practicing clinicians.

In exact parallel to regressing people so they supposedly retrieve forgotten memories of "past lives," Frankel notes that therapists can as readily progress people under hypnosis so they *can* "remember" their futures. This elicits the same emotive intensity as in regression or in Mack's abductee hypnosis. "These people are not out to deceive the therapist. They deceive themselves," Frankel says. "They cannot distinguish their

confabulations from their experiences."

If we fail to cope, if we're saddled with a burden of guilt for not having made more of ourselves, wouldn't we welcome the professional opinion of a therapist with a diploma on the wall that it's not our fault, that we're off the hook, that satanists, or sexual abusers, or aliens from other planets are the responsible parties? Wouldn't we be willing to pay good money for this reassurance? And wouldn't we resist smart-ass skeptics telling us that it's all in our heads, or that it's implanted by the very therapists who have made us happier about ourselves?

How much training in scientific method and skeptical scrutiny, in statistics, or even in human fallibility have these therapists received? Psychoanalysis is not a very self-critical ~~discipline~~ ^{profession,} but at least many of its practitioners have M.D. degrees. Most medical curricula include significant exposure to scientific results and methods. But many of those dealing with abuse cases seem to have at best a casual acquaintance with science. Mental health providers in America are more likely by about two-to-one to be social workers than either psychiatrists or Ph.D. psychologists.

Might the competition among therapists for patients make them less likely to offend patients by evincing some skepticism about their stories? How aware are they of the dilemma of a naive patient walking into a professional office and being told that the insomnia or obesity is due (in increasing order of

bizarreness) to wholly forgotten parental abuse, satanic ritual, or alien abduction? While there are ethical and other constraints, we need something like a controlled experiment: perhaps the same patient sent to specialists in all three fields. Does any of them say, "No, your problem isn't due to forgotten childhood abuse" (or forgotten satanic ritual, or alien abduction, as appropriate)? How many of them say, "There's a much more prosaic explanation"?

A typical UFO therapist finds his subjects in three ways: They write letters to him at an address given in the back of his books; they are referred to him by other therapists (mainly those who also specialize in abductions); or they come up to him after he presents a lecture. I wonder if any patient arrives at his portal wholly ignorant of popular abduction accounts and the therapist's own methods and beliefs. Before any words are exchanged, they know a great deal about one another.

Another prominent therapist gives his patients his own articles on alien abductions to help them "remember" their experiences. He is gratified when what they eventually recall under hypnosis is like what he describes in his papers. The similarity of the cases is one of his chief reasons for believing that abductions really occur.

A leading UFO scholar comments that "When the hypnotist does not have an adequate knowledge of the subject [of alien abductions], the true nature of the abduction may never be

revealed." Can we discern in this remark how the patient might be led without the therapist realizing that he's leading?

* * *

Sometimes when "falling" asleep we have the sense of falling from a height, and our limbs suddenly flail on their own. The startle reflex, it's called. Perhaps it's left over from when our ancestors slept in trees. All of us have had vivid waking memories which turned out to be false. Why should we imagine we recollect (a wonderful word) any better than we know when we're on firm ground? Why should we suppose that, of the vast treasure of memories stored in our heads, none of it could have been implanted after the event -- by how a question is phrased when we're in a suggestible frame of mind, by the pleasure of telling or hearing a good story, by confusion with something we once read or overheard? ~~[All of these things commonly happen. Very rarely are our memories "photographic." Especially when the stakes are high, it is wise not to trust our recollections too far.]~~

[M, 11/28/94]

Chapter 9

THE DRAGON IN MY GARAGE

[M]agic, it must be remembered, is an art which demands collaboration between the artist and his public.

-- E. M. Butler, The Myth of the Magus (1948)

"A fire-breathing dragon lives in my garage."

Suppose (I'm following a group therapy approach by the psychologist Richard Franklin) I seriously make such an assertion to you. Surely you'd want to check it out, see for yourself. There have been innumerable stories of dragons over the centuries, but no real evidence. What an opportunity!

"Show me," you say. I lead you to my garage. You look inside and see a ladder, empty paint cans, an old tricycle -- but no dragon.

"Where's the dragon?" you ask.

"Oh, she's right here," I reply, waving vaguely. "I neglected to mention that she's an invisible dragon."

You propose spreading flour on the floor of the garage to capture the dragon's footprints.

"Good idea," I say, "but this dragon floats in the air."

Then you'll use an infrared sensor to detect the invisible fire.

"Good idea, but the invisible fire is also heatless."

You'll spray-paint the dragon and make her visible.

"Good idea, except she's an incorporeal dragon and the paint won't stick."

And so on. I counter every physical test you propose with a special explanation of why it won't work.

Now, what's the difference between an invisible, incorporeal, floating dragon who spits heatless fire and no dragon at all? If there's no way to disprove my contention, no conceivable experiment that would count against it, what does it mean to say that my dragon exists? Claims that cannot be tested, assertions immune to disproof are worthless. What I'm asking you to do comes down to believing, in the absence of evidence, on my say-so.

The only thing you've really learned from my insistence that there's a dragon in my garage is that something funny is going on inside my head. You'd wonder, if no physical tests apply, what convinced me. The possibility that it was a dream or a hallucination would certainly enter your mind. But then why am I taking it so seriously? Maybe I need help. *At the least, maybe I've seriously underestimated human fallibility.*

Imagine that, despite none of the tests being successful, you wish to be scrupulously open-minded. So you don't outright reject the notion that there's a fire-breathing dragon in my garage. You merely put it on hold. Present evidence is strongly against it, but if new data emerges ^{*we prepared*} ~~you would be ready~~ to examine it and see if it convinces you. Surely it's unfair of me to be offended at not being believed; or to criticize you for being

stodgy and unimaginative -- merely because you rendered the Scottish verdict of "not proved."

Imagine that things had gone otherwise. The dragon is invisible, all right, but footprints are being made in the flour as you watch. Your thermistor reads off-scale. The spray paint reveals a jagged crest bobbing in the air before you. No matter how skeptical you might have been about the existence of dragons -- to say nothing about invisible ones -- you must now acknowledge that there's something here, and that in a preliminary way it's consistent with an invisible, fire-breathing dragon.

Now one last scenario: Suppose it's not just me. Suppose that ^{a number of} ~~several~~ people of your acquaintance, including people who you're pretty sure don't know each other, all tell you they have dragons in their garages -- but in every case the evidence is maddeningly elusive. ^{All of us} ~~We~~ admit we're disturbed at being gripped by so odd a conviction so ill-supported by the physical evidence. None of us is a lunatic. We speculate about what it would mean if invisible dragons were really hiding out in garages all over the world, ^{with us} ~~and we~~ humans ~~were~~ just catching on. I'd rather it not be true, I tell you. But maybe all those ancient European and Chinese myths about dragons were not myths at all. . .

Gratifyingly, some dragon-size footprints in the flour are now reported. But they're never made when a skeptic is looking. On close examination it seems clear that they could have been

faked. Another dragon enthusiast shows up with a burnt finger and attributes it to a rare physical manifestation of the dragon's fiery breath. Well, we understand that there are other ways to burn fingers besides the breath of invisible dragons. Such evidence -- no matter how important the dragon advocates consider it -- is far from compelling. Once again, the only sensible approach is tentatively to reject the dragon hypothesis, to be open to future physical data, and to wonder what the cause might be that so many apparently sane and sober people share the same strange delusion.

* * *

Magic requires tacit cooperation of the audience with the magician -- an abandonment of skepticism, or what is sometimes described as the willing suspension of disbelief. It immediately follows that to penetrate the magic, to expose the trick, we must cease collaborating.

How can further progress be made in this emotionally-laden, controversial, and vexing subject? Those treating abductees might explain to their patients that hallucinations are normal, and that childhood sexual abuse is disconcertingly common. They might bear in mind that no patient can be wholly uncontaminated by the aliens in popular culture. They might take scrupulous care not subtly to lead the witness. They might teach their

patients skepticism. They might recharge their own dwindling reserves of the same commodity.

Purported alien abductions trouble many people and in more ways than one. The subject is a window into the internal lives of our fellows. If many falsely report being abducted, this is cause for worry. But much more worrisome is that many therapists accept these reports at face value -- with inadequate attention given to the suggestibility of patients and to unconscious cuing by their interlocutors. ~~All this is part of a much broader problem -- appallingly low levels of critical thinking, which poses dangers at all levels of society.~~

I'm surprised that there are psychiatrists and others with at least some scientific training, who know the imperfections of the human mind, but who dismiss the idea that these accounts might be some species of hallucination, or some kind of screen memory. I'm even more surprised by claims that the alien abduction story represents true magic, that it is a challenge to our grip on reality, or that it constitutes support for a mystical view of the world. Or, as the matter is put by John Mack, "There are phenomena important enough to warrant serious research, and the metaphysics of the dominant Western scientific paradigm may be inadequate fully to support this research." In an interview with Time magazine, he goes on to say:

I don't know why there's such a zeal to find a conventional physical explanation. I don't know why people have such trouble simply accepting the fact that something unusual is going on here. . . . We've lost all that ability to know a

world beyond the physical.*

But we know that hallucinations arise from sensory deprivation, drugs, illness and high fever, a lack of REM sleep, changes in brain chemistry, and so on. And even if, with Mack, we took the cases at face value, their remarkable aspects -- slithering through walls and so on -- are more readily attributable to advanced alien technology than to witchcraft.

A friend of mine claims that the only interesting question in the alien abduction paradigm is "Who's conning who?" Is the patient deceiving the therapist, or vice versa? I disagree with my friend. For one thing, there are many other interesting questions about claims of alien abductions. For another, those two alternatives aren't mutually exclusive:

Something about the alien abduction cases tugged at my memory for years. Finally, I remembered. It was a 1954 book I had read in college, The Fifty-Minute Hour. The author, a psychiatrist named Robert Lindner, had been called by the Los Alamos National Laboratory to treat a brilliant young nuclear physicist whose delusional system was beginning to interfere with his secret government research. The physicist (given the pseudonym Kirk Allen) had, it turned out, another life besides making nuclear weapons: In the far future, he confided, he *(or will pilot -- the tenses get a little addled)* piloted interstellar spacecraft, enjoyed rousing, swashbuckling

*And then, in a sentence that reminds us how close the alien abduction paradigm is to messianic and chiliastic religion, Mack concludes, "I am a bridge between those two worlds."

adventures on planets of other stars, ^{He} and was "lord" of many worlds. Perhaps they called him Captain Kirk. Not only could he "remember" this other life; he could also enter into it whenever he chose. By thinking in the right way, by wishing, he could transport himself across the light years and the centuries.

In some way I could not comprehend, by merely desiring it to be so, I had crossed the immensities of space, broken out of time, and merged with -- literally become -- that distant and future self. . . Don't ask me to explain. I can't, although God knows I've tried.

Lindner found him intelligent, sensitive, pleasant, polite, and perfectly able to deal with everyday human affairs. But -- in reflecting on the excitement of his life among the stars -- Allen had found himself a little bored with his life on Earth, even if it did involve building weapons of mass destruction. When chastised by his laboratory supervisors for distraction and dreaminess, he apologized; he would try, he assured them, to spend more time on this planet. That's when they contacted Lindner.

Allen had written 12,000 pages on his experiences in the future, and dozens of technical volumes on the geography, politics, architecture, astronomy, geology, life forms, genealogy, and ecology of the planets of other stars. A flavor of the material is given by these monograph titles: "The Unique Brain Development of the Chrystopeds of Srom Norba X," "Fire Worship and Sacrifice on Srom Sodrat II," "The History of the Intergalactic Scientific Institute," and "The Application of

Unified Field Theory and the Mechanics of the Stardrive to Space Travel." (That last is the one I'd like to see; after all, Allen was said to have been a first-rate physicist.) Fascinated, Lindner pored over the material.

Allen was not in the least shy about presenting this material to Lindner or discussing it in detail. Unflappable and intellectually formidable, he seemed not to be yielding an inch to Lindner's psychiatric ministrations. When everything else failed, the psychiatrist attempted something different:

I tried. . . to avoid giving in any way the impression that I was entering the lists with him to prove that he was psychotic, that this was to be a tug of war over the question of his sanity. Instead, because it was obvious that both his temperament and training were scientific, I set myself to capitalize on the one quality he had demonstrated throughout his life. . . the quality that urged him toward a scientific career: his curiosity. . . This meant. . . that at least for the time being I "accepted" the validity of his experiences. . . In a sudden flash of inspiration it came to me that in order to separate Kirk from his madness it was necessary for me to enter his fantasy and, from that position, to pry him loose from the psychosis.

Lindner highlighted certain apparent contradictions in the documents and asked Allen to resolve them. This required the physicist to re-enter the future to find the answers. Dutifully, Allen would arrive at the next psychiatric session with a clarifying document written in his neat hand. Lindner found himself eagerly awaiting each interview, so he could be once more captivated by the vision of abundant life and intelligence in the Galaxy. Between them, they were able to resolve many problems of consistency.

Then a strange thing happened: "The materials of Kirk's psychosis and the Achilles heel of my personality met and meshed like the gears of a clock." The psychiatrist became a co-conspirator in his patient's delusion. He began to reject psychological explanations of Allen's story. Are we really sure it couldn't be true? He found himself defending the idea that another life, that of a spacefarer in the far future, could be entered into by a simple effort of the will.

At a startlingly rapid rate. . . larger and larger areas of my mind were being taken over by the fantasy. . . With Kirk's puzzled assistance I was taking part in cosmic adventures, sharing the exhilaration of the sweeping extravaganza he had plotted.

But eventually, an even stranger thing happened: Concerned for the well-being of his therapist, and mustering admirable reserves of integrity and courage, Kirk Allen confessed: He had made the whole thing up. It had roots in his lonely childhood and his unsuccessful relationships with women. He had shaded, and then forgotten the boundary between reality and imagination. Filling in plausible details and weaving a rich tapestry about other worlds was challenging and exhilarating. He was sorry he had led Lindner down this primrose path.

"Why," the psychiatrist asked, "why did you pretend? Why did you keep on telling me. . .?"

"Because I felt I had to," the physicist replied. "Because I felt you wanted me to."

"Kirk and I reversed roles," Lindner explained, and, in one of those startling denouements that make my work

the unpredictable, wonderful and rewarding pursuit it is, the folly we shared collapsed. . . I employed the rationalization of clinical altruism for personal ends and thus fell into a trap that awaits all unwary therapists of the mind. . . Until Kirk Allen came into my life, I had never doubted my own stability. The aberrations of mind, so I had always thought, were for others. . . I am shamed by this smugness. But now, as I listen from my chair behind the couch, I know better. I know that my chair and the couch are separated only by a thin line. I know that it is, after all, but a happier combination of accidents that determines, finally, who shall lie on the couch, and who shall sit behind it.

I'm not sure from this account that Kirk Allen was truly delusional. Maybe he was just suffering from some ~~serious~~ character disorder which delighted in inventing charades at the expense of others. I don't know to what extent Lindner may have embellished the story. While he wrote of "sharing" and of "entering" Allen's fantasy, there is nothing to suggest that the psychiatrist imagined he himself voyaged to the far future and partook of interstellar high adventure. Likewise, John Mack and the other alien abduction therapists do not suggest that they have been abducted; only their patients.

What ~~would have happened had~~ ^{if} the physicist ~~not~~ ^{hadn't} confessed? Might Lindner have convinced himself, beyond a reasonable doubt, that it really was possible to slip a more romantic era? Would he have said he started out as a skeptic, but was convinced by the sheer weight of the evidence? Might he have advertised himself as an expert who assists space travelers from the future who are stranded in the twentieth century? Would the existence of such a psychiatric specialty encourage others to take

fantasies or delusions of this sort seriously? After a few similar cases, would Lindner have impatiently resisted all arguments of the "Be reasonable, Bob" variety, and deduced he was penetrating some new level of reality?

His scientific training helped to save Kirk Allen from his madness. There was a moment when psychiatrist and patient had exchanged roles. I like to think of it as the patient saving the psychiatrist. Perhaps John Mack was not so lucky.

* * *

Consider a very different approach to finding aliens -- the radio search for extraterrestrial intelligence. How is this different from pseudoscience? In the early 1960s, Soviet astronomers held a press conference in Moscow in which they announced that the radio emission from a distant object called CTA-102 was varying regularly, like a sine wave, with a period of about 100 days. No periodic distant source had ever before been found. Why did they convene a press conference to announce so arcane a discovery? Because they thought they had detected an extraterrestrial civilization of immense powers. Surely, that's worth calling a press conference for. The report was briefly a media sensation, and the rock group, The Byrds, even ~~composed and~~ recorded a song about CTA-102. ["CTA-102, we're over here receiving you. / Signals tell us that you're there. / We can hear them loud and clear..."]

A ~~Big~~ Radio emission from CTA-102? Certainly. But what is CTA-102?

Today we know that CTA-102 is a distant quasar. At the time, the word "quasar" had not even been coined. We still don't know very well what quasars are; and there is more than one mutually exclusive explanation for them in the scientific literature. Nevertheless, no astronomers today -- including those involved in that Moscow press conference -- seriously contend that a quasar like CTA-102 is some extraterrestrial civilization billions of light years away with access to immense power levels. Why not? Because we have alternative explanations of the properties of quasars that are consistent with known physical laws and that do not invoke alien life. Extraterrestrials represent a hypothesis of last resort. You reach for it only if everything else fails.

In 1967, British scientists found a much nearer intense radio source turning on and off with astonishing precision, its period constant to ten significant figures. What was it? Their first thought was that it was a message intended for us, or maybe an interstellar navigation and timing beacon for spacecraft that ply the seas between the stars. They even gave it, among themselves at Cambridge University, the wry designation LGM-1 -- LGM standing for Little Green Men.

However, they were wiser than the Soviet radio astronomers. They did not call a press conference. It soon became clear that what they were observing was what is now called a "pulsar," the first pulsar, the Crab Nebula pulsar. So, what's a pulsar? A

pulsar is the end state of a massive star, a sun shrunk to the size of a city, held up as no other stars are, not by gas pressure, not by electron degeneracy, but by nuclear forces. It is in a certain sense an atomic nucleus a mile or so across. Now that, I maintain, is a notion at least as bizarre as an interstellar navigation beacon. The answer to what a pulsar is has to be something mighty strange. It isn't an extraterrestrial civilization. It's something else: but a something else that opens our eyes and our minds and indicates unguessed possibilities in Nature. Anthony Hewish won the Nobel Prize in physics for the discovery of pulsars.

The original Ozma experiment (the first intentional radio search for extraterrestrial intelligence), the Harvard University/Planetary Society META (Megachannel Extraterrestrial Assay) program, the Ohio State University search, the SERENDIP Project of the University of California, Berkeley, and many other groups have all detected anomalous signals from space that make the observer's heart palpitate a little. We think for a moment that we've picked up a genuine signal of intelligent origin from far beyond our solar system. In reality, we have not the foggiest idea what it is, because the signal does not repeat. A few minutes later, or the next day, or years later you turn the same telescope to the same spot in the sky with the same frequency, bandpass, polarization, and everything else, and you don't hear a thing. You don't deduce, much less announce,

aliens. It may have been a statistically inevitable electronic surge, or a malfunction in the detection system, or a spacecraft (from Earth), or a military aircraft flying by and broadcasting on channels that are supposed to be reserved for radio astronomy. Maybe it's even a garage door opener down the street or a radio station a hundred kilometers away. There are many possibilities. You must systematically check out all the alternatives, and see which ones can be eliminated. You don't declare that aliens have been found when your only evidence is an enigmatic nonrepeating signal.**

And if the signal did repeat, would you then announce it to the press and the public? You would not. Maybe ^{someone's} ~~it's~~ a hoaxing you. Maybe it's something you haven't been smart enough to figure out that's happening to your detection system. Maybe it's some previously unrecognized astrophysical source. Instead, you would call scientists at other radio observatories and inform them that at this particular spot in the sky, at this frequency and bandpass and all the rest, you seem to be getting something funny. Could they please see if they can confirm? Only if several independent observers -- all of them fully aware of the complexity of Nature and the fallibility of observers -- get the same kind of information from the same spot in the sky do you seriously consider that you have detected a genuine signal from

**I describe these tantalizing observations in greater detail in Pale Blue Dot: A Vision of the Human Future in Space (New York: Random House, 1994).

alien beings.

(and is the radio pioneers Nikola Tesla and Guglielmo Marconi did in, respectively, 1901 and 1920)

There's a certain discipline involved. We can't just go off shouting "little green men" every time we detect something we don't at first understand, because we're going to look mighty silly -- as the Soviet radio astronomers did with CTA-102 -- when it turns out to be something else. Special cautions are necessary when the stakes are high. We are not obliged to make up our minds before the evidence is in. It's permitted not to be sure.

I'm frequently asked, "Do you ^{believe} ~~think~~ there's extraterrestrial intelligence?" I give the standard arguments -- there are a lot *the molecules of life are everywhere,* of places out there, and use the word billions, and so on. Then I say it would be astonishing to me if there weren't extraterrestrial intelligence, but of course there is as yet no compelling evidence for it.

Often, I'm asked next, "But [?] ~~what~~ what do you really think?"

I say, "I just told you what I really think."

"Yes, but what's your gut feeling?"

^{But} I try not to think with my gut. If I'm serious about understanding the world, thinking with anything besides my brain, as tempting as that might be, is likely to get me into trouble. Really, it's okay to reserve judgment until the evidence is in.

* * *

I would be very happy if flying saucer advocates and alien abduction proponents were right and real evidence of extraterrestrial life were here for us to examine. ~~Now~~ ^{though,} they do not ask us to believe on faith. They ask us to believe on the strength of their evidence. Surely it is our duty to scrutinize the purported evidence at least as closely and skeptically as radio astronomers do who are searching for alien radio signals.

No anecdotal claim -- no matter how sincere, no matter how deeply felt, no matter how exemplary the lives of the attesting citizens -- carries much weight on so important a question. As in the older UFO cases, anecdotal accounts are subject to irreducible error. This is not a personal criticism of those who say they've been abducted or of those who interrogate them. It is not tantamount to contempt for ~~those who claim to be~~ ^{purported} witnesses.*** It is not -- or should not be -- arrogant dismissal of sincere and affecting testimony. It is merely a reluctant response to ~~irreducible~~ human fallibility.

If any powers whatever may be ascribed to the aliens -- because their technology is so advanced -- then we can "explain" any discrepancy, inconsistency, or implausibility. For instance, one academic UFOlogist suggests that both the aliens and the abductees are rendered invisible during the abduction (although not to each other); that's why more of the neighbors haven't

*** They cannot be called, simply, witnesses -- because whether they witnessed anything (or, at least, anything in the outside world) is often the very point at issue.

noticed. Such "explanations" can explain anything, and therefore in fact nothing.

American police procedure concentrates on evidence and not anecdotes. ^{As the European witch trials remind us,} Suspects can be intimidated during interrogation; ^s Some people confess to crimes they never committed; ^e Eyewitnesses can be mistaken. ^{also} ~~This is the linchpin of much detective fiction.~~ But real, unfabricated evidence -- powder burns, fingerprints, DNA samples, footprints, hair under the fingernails of the struggling victim -- carry great weight. Criminalists employ something very close to the scientific method, and for the same reasons. So in the world of UFOs and alien abductions, it is fair to ask: Where is the evidence -- the real, unambiguous physical evidence, the data that ^{would} ~~will~~ convince a jury that hasn't already made up its mind?

Some enthusiasts argue that there are "thousands" of cases of disturbed soil where UFOs supposedly landed, and why isn't that good enough? It isn't good enough because there are ways of disturbing the soil other than by aliens in UFOs -- humans with shovels is a possibility that springs readily to mind. One UFOlogist rebukes me for ignoring "4400 physical trace cases from 65 countries." But not one of these cases, so far as I know, has been analyzed, with results published in a peer-reviewed journal in physics or chemistry, ^{metallurgy or soil science,} showing that the "traces" could not have been generated by people.

Likewise, not only can photographs easily be faked, but huge numbers of ^{alleged} ~~purported~~ photographs of UFOs have without a doubt been faked. Some enthusiasts go out night after night into a field looking for bright lights in the sky. When they see one, they flash their flashlights. Sometimes, they say, there's an answering flash. Well, maybe. But low-altitude aircraft make lights in the sky, and pilots are able, if they are so inclined, to blink their lights ^{back.} None of this constitutes anything approaching serious evidence.

Betty Hill's "star map," it is alleged, constitutes strong evidence. The story is this: Ms. Hill reported that the captain of the UFO onto which she says she was abducted showed her a wall map; many nearby stars were represented (including the Sun), with trade and other routes displayed as lines connecting the dots. She made no record of the map at the time. Many years later, alongside a newspaper article about a quasar (it was, in fact, CTA-102, billions of light years away), Betty saw another "star map" which she immediately "recognized" as the very one she had seen aboard the UFO. Her recollection thus refreshed, she was now able to draw the original map "from memory." Years after that, an Ohio school teacher argued that the Hill map was indeed a representation of nearby stars as seen from a particular vantage point in space which she arbitrarily chose. One of those stars is Zeta Reticuli (it's actually a double star system), which, because of its faintness, was undiscovered and

unrepresented on astronomical maps at the time the Hills claimed to have been abducted. Accordingly, some UFOlogists conclude, the star map must be real: No one on Earth could have drawn it in 1961.

This is an unpersuasive argument for at least two reasons: (1) Accurately remembering a particular irregular configuration of ten or twenty dots for many years without ever committing it to paper is extremely difficult to do; and (2) Steven Soter (now at the Smithsonian Institution) and I have shown that as good a match to the Hills' "star map" as the one involving Zeta Reticuli can be obtained from a random distribution of an equal number of points in three-dimensional space: If you're free to pick a position anywhere near this cluster of dots -- above, below, to the side, etc. -- then you can almost always find a perspective from which one set of dots looks like another, to within the error deemed acceptable for the Zeta Reticuli match. We were able to get a better match to the Hill map with a random collection of dots than the school teacher got with the set of nearby stars. The "star map," it turns out, is no evidence at all.

It's often like this. A case is touted as providing good, even compelling evidence. You look at it closely and find that a crucial confirming detail is absent, or there's evidence for fraud, or the proposed evidence is internally contradictory, or even the principal witness admits to perpetrating a hoax. That's

all right; UFO partisans then just move on to the next "case." There are thousands of cases. One more or less will never be missed. Or sometimes, what was wrong with the previous case is, after the passage of a little time, overlooked or forgotten, or never registered in the first place. A greatly distorted presentation of the "star map" story was included as coda to ^a ~~the~~ made-for-TV movie about the Betty and Barney Hill case, and offered as confirmation that they were abducted as alleged. In current UFO accounts, "reptoid" aliens come from Zeta Reticuli. Someone thought, in light of the initial Hill star map argument, that this sounded credible. ~~People want to believe.~~

Where is the physical evidence? As in satanic ritual abuse ^(and echoing "Devil's marks" in the witch trials) claims, the most common physical evidence pointed to are scars and "scoop marks" on the bodies of abductees -- who say they have no knowledge of where these ^{is} ~~are~~ scars came from. But this point is key: If the scars are within human capacity to generate, then they cannot be compelling physical evidence of abuse by aliens. Indeed, there are well-known psychiatric disorders in which people scoop, scar, tear, cut, and mutilate themselves (or others). And some of us with high pain thresholds and bad memories can injure ourselves accidentally with no recollection of the event.

One of John Mack's patients claims to have scars all over her body that are wholly baffling to her physicians. What do they look like? Oh, she can't show them; ^{as in the witch mania,} they're in private

places. Mack considers this compelling evidence. Has he seen the scars? Can we have photographs of the scars taken by a skeptical physician? Mack knows, he says, a quadriplegic with scoop marks and considers this a reductio ad absurdum of the skeptical position; how can a quadriplegic scar himself? The argument is a good one only if the quadriplegic is hermetically sealed in a room to which no other human has access. Can we see his scars? Can an independent physician examine him? Another of Mack's patients says that the aliens have been taking eggs from her since she was sexually mature, and that her reproductive system baffles her gynecologist. Is it baffling enough to write the case up and submit a research paper to The New England Journal of Medicine? Apparently it's not that baffling.

Then we have the fact that one of his subjects made the whole thing up, as reported by Time magazine, and Mack didn't have a clue. He bought it hook, line, and sinker. What are his standards of critical scrutiny? If he allowed himself to be deceived by one subject, how do we know the same wasn't true of all?

Mack talks about these cases, the "phenomena," as posing a fundamental challenge to Western thinking, to science, to logic itself. Probably, he says, the abducting entities are not alien beings from our own universe, but visitors from "another dimension." Now the idea of higher dimensions does not arise from the brow of UFOlogy or the New Age. Instead, it is part and

parcel of the physics of the twentieth century. Since Einstein's general relativity, a truism of cosmology is that space-time is bent or curved through a higher physical dimension. Kaluza-Klein theory posits an eleven-dimensional universe. Mack presents a thoroughly scientific idea as the key to "phenomena" beyond the reach of science.

For clarity, let's go down one dimension:

We know something about how a higher-dimensional object would look in encountering our three-dimensional universe. An apple passing through a plane must change its shape as perceived by two-dimensional beings confined to the plane. *First it seems to be* ~~from~~ *then* a point, to larger apple cross-sections, then ~~to~~ smaller ones, a point again -- and finally, poof!, gone. Similarly, a fourth- or higher-dimensional object -- provided it's not a simple ~~geometrical~~ figure such as a hypercylinder -- will wildly alter its geometry as we witness *it passing through our* ~~different three-dimensional cuts through its universe.~~ ~~higher-dimensional shape.~~ If aliens were systematically reported as shape-changers, I could at least see how Mack might pursue the notion of a higher-dimensional origin. (Another problem I have is trying to understand what a genetic cross between a three-dimensional and a four-dimensional being means. Are the offspring from the 3½th dimension?) *9* What Mack really means when he talks about beings from other dimensions is that he hasn't a clue what they are. But, tellingly, when he tries to describe them, he reaches for physics and mathematics. He wants it both ways -- the language and credibility of science, but without

being bound by its method and rules. He seems not to realize that the credibility is a consequence of the method.

The main challenge posed by Mack's cases is the old one of how to teach critical thinking more broadly and more deeply in a society -- conceivably even including Harvard professors of psychiatry -- awash in gullibility. The idea that critical thinking is the latest Western ^{Fad} ~~fashion~~ is silly. If you're ^{-- or a used chariot in ancient Susa or Rome --} buying a used car in Singapore or Bangkok, the same precautions will be useful as in Cambridge, Massachusetts.

When you buy a used car, you might very much want to believe what the salesman is saying: "So much car for so little money!" And anyway, it takes work to be skeptical; you have to know something about cars, and it's unpleasant to make the salesman angry at you. Despite all that, though, you recognize that the salesman might have a motive to shade the truth, and you've heard of other people in similar situations being taken. So you kick the tires, look under the hood, go for a test drive, ask searching questions. You might even bring along a mechanically-inclined friend. You know that some skepticism is required, and you understand why. There is usually at least a small degree of hostile confrontation involved in the purchase of a used car and nobody claims it's an especially cheerful ^{ing} ~~ful~~ experience. But if you don't exercise some minimal skepticism, if you have an absolutely untrammelled gullibility, there's a price you'll have to pay later. Then you'll wish you had made a small investment of

skepticism early on.

A ~~fair~~ number of homes in America now have moderately sophisticated burglar alarm systems, including infrared sensors and cameras triggered by motion. An authentic videotape, with time and date denoted, showing an alien incursion -- especially as they slip through the walls -- might be very good evidence. If millions of Americans have been abducted, isn't it strange that not one lives in such a home?

Some women, so the story goes, are impregnated by aliens or alien sperm; the fetuses are then removed by the aliens. Vast numbers of such cases are alleged. Isn't it odd that nothing anomalous has ever been seen in routine sonograms of such fetuses, or in amniocentesis, and that there has never been a miscarriage delivering an alien hybrid? Or are medical personnel so doltish that they idly glance at a half-human, half-alien fetus and move on to the next patient? An epidemic of missing fetuses is something that would surely cause a stir among gynecologists, midwives, obstetrical nurses -- especially in an age of heightened feminist awareness. But not a single medical record has been produced substantiating such claims.

Some UFOlogists consider it a telling point that women who claim ~~not~~ to have been sexually ⁱⁿ active wind up pregnant, and attribute their state to alien impregnation. A goodly number appear to be teenagers. Taking their stories at face value is not the only option available to the serious investigator.

Surely we can understand why, in the anguish of an unwanted pregnancy, a teenager living in a society flooded with accounts of alien visitation might invent such a story. *Here, too, there are possible religious antecedents.*

Some abductees say that tiny metallic implants were inserted into their bodies -- high up their nostrils, for example. These implants, alien abduction therapists tell us, sometimes accidentally fall out, but "in all but a few of the cases the artifact has been lost or discarded." These abductees seem stupefyingly incurious. A metal object -- possibly a transmitter sending telemetered data about the state of your body to an alien spaceship somewhere above the Earth -- drops out of your nose; you idly examine it and then throw it in the garbage. Something like this is true, we are told, of the majority of abduction cases.

A few such "implants" have been produced and examined by experts. None has been confirmed as of unearthly manufacture. No components are made of unusual isotopes, despite the fact that other stars and other worlds are known to be made of different isotopic proportions than the Earth. There are no metals from the transuranic "island of stability," where physicists think there might be a new family of nonradioactive chemical elements unknown on Earth. There is no retrieval of cunning machinery far beyond current technology. No abductee has filched a page from the captain's logbook, or an examining instrument, or taken an authentic photograph of the interior of the ship, or come back

with detailed and verifiable scientific information not hitherto available on Earth. Why not? These failures must tell us something.

Since the middle of the twentieth century,
~~For decades~~ we've been assured by proponents of the extraterrestrial hypothesis that physical evidence -- not maps remembered from years ago, not scars, not disturbed soil, but

real alien technology -- was in hand. The analysis would be released momentarily. *These claims go back to the earliest crashed saucer scam of Newton and GoBauer.* Now it's decades later and we're still

waiting. Where are the articles published in the refereed scientific literature, in the metallurgical and ceramics journals, in publications of the Institute of Electrical and Electronic Engineers, in Science or Nature?

Such a discovery would be momentous. If there were real artifacts, physicists and chemists would be fighting for the privilege of discovering that there are aliens among us -- who use, say, ~~wholly~~ unknown alloys, or materials of extraordinary tensile strength or ductility or conductivity. The practical implications of such a finding -- never mind the confirmation of an alien invasion -- would be immense. Discoveries like this are what scientists live for. Their absence must tell us something.

* * *

Keeping an open mind is a virtue -- but, as the space engineer James Oberg once said, not so open that your brains fall

[12-11-94.at1]

Quint 14, Ch 9, p. 27

For The Demon-Haunted World:

(N.A.) The standard of evidence in most of the alien abduction
cases is ~~not even up to that~~ *roughly what is found* in cases of the apparition of ~~angels~~
Mary or the Virgin in late medieval Spain.

out. Of course we must be willing to change our minds when warranted by new evidence. But the evidence must be substantive. Not all claims to knowledge have equal merit. *Smart H*

~~Speaking of psychiatrists,~~ *T*he pioneering psychoanalyst, Carl Gustav Jung, had much that was sensible to say on issues of this sort. He explicitly argued that UFOs were a kind of projection of the unconscious mind. In a related discussion of regression and what today is called "channeling," he wrote

One can very well. . . take it simply as a report of psychological facts or a continuous series of communications from the unconscious. . . They have this in common with dreams; for dreams, too, are statements about the unconscious. . . The present state of affairs gives us reason enough to wait quietly until more impressive physical phenomena put in an appearance. If, after making allowance for conscious and unconscious falsification, self-deception, prejudice, etc., we should still find something positive behind them, then the exact sciences will surely conquer this field by experiment and verification, as has happened in every other realm of human experience.

Of those who accept such testimony at face value, he remarked

These people are lacking not only in criticism but in the most elementary knowledge of psychology. At bottom they do not want to be taught any better, but merely to go on believing -- surely the naivest of presumptions in view of our human failings.

Perhaps some day there will be a UFO or alien abduction case that is well-attested, accompanied by compelling physical evidence, and explicable only in terms of extraterrestrial visitation. It's hard to think of a more important discovery. So far, though, there have been no such cases, nothing that comes close. The invisible dragon has not materialized.

So which is more likely: that we're undergoing a massive

but generally overlooked invasion by alien sexual abusers, or that people are experiencing some unfamiliar internal mental state they do not understand? Admittedly, we're very ignorant both about extraterrestrial beings, if any, and about human psychology. But if these really were the only two alternatives, which one would you pick?

And if the alien abduction accounts are mainly about ^{brain physiology,} hallucinations and screen memories of childhood, don't we have before us a matter of supreme importance -- touching on our limitations, the ease with which we can be misled and manipulated, the fashioning of our beliefs, and perhaps even the origins of our religions? There is genuine scientific paydirt in UFOs and alien abductions -- but it is, I think, of a distinctly homegrown and terrestrial character.

[M, 11/28/94]

Chapter 10

THE CITY OF GRIEF

. . . how alien, alas, are the streets of the city of grief.

-- Rainer Maria Rilke, "The Tenth Elegy" (1923)

A short summary of the argument in the preceding six chapters appeared in Parade magazine on March 7, 1993. I was struck by how many letters it evoked, how passionate were the responses, and how much agony is associated with this strange experience -- whatever its true explanation might be. Alien abduction accounts provide an unexpected window into the lives of some of our fellow citizens. Some letter-writers reasoned, some asserted, some harangued, some were frankly perplexed, some were deeply troubled.

The article was also widely misunderstood. A television talk-show host, Geraldo Rivera, held up a copy of Parade and announced I thought we were being visited. A Washington Post video cassette reviewer quoted me as saying there's an abduction every few seconds, missing the ironical tone and the following sentence ("It's surprising more of the neighbors haven't noticed"). And to round it out, my description (Chapter 6) of on rare occasions seeming to hear the voices of my dead parents -- what I described as "a lucid recollection" -- were keynoted by Raymond Moody, in the New Age Journal and in ^{the Introduction} ~~Chapter 1~~ [check] of his book Reunions, as evidence that we "survive" death. Dr.

Moody has spent his life trying to find evidence for life after death. If my testimony is worth quoting, it seems clear he hasn't found much. Many letter writers concluded that since I had worked on the possibility of extraterrestrial life, I must "believe" in UFOs; or conversely that, if I was skeptical about UFOs, I must ~~hold~~^{embrace} the absurd belief that humans are the ~~sole~~^{only} intelligent beings in the Universe. There's something about this subject uncondusive to clear thinking.

Here, without further comment, is a representative sampling of my mail on the subject:

• I wonder how some of our fellow animals may describe their encounters with us. They see a large hovering object making a terrible noise above them. They begin to run and feel a sharp pain in their side. Suddenly they fall to the ground. . . Several man-creatures approach them carrying strange looking instruments. They examine your sexual organs and teeth. They place a net under you and then let it take you in the air with a strange device. After all the examinations, they then clamp a strange metal object to your ear. Then, just as suddenly as they had appeared, they are gone. Eventually, muscle control returns, and the poor disoriented creature staggers off into the forest, not knowing [whether] what just transpired was a nightmare or a reality.

• I was sexually abused as a child. In my recovery I have drawn many "space beings" and have felt many times I was being overpowered, held down, and the sensation of having left my body to float around the room. None of the abductee accounts really come as a surprise to someone who has dealt with childhood sexual abuse issues. . . . Believe me, I would much rather have blamed my abuse on a space alien than have to face the truth about what happened to me with the adults I was supposed to be able to trust. It's been driving me crazy to hear some of my friends speak of their memories that imply they have been abducted by aliens. . . . I keep saying to them that this is the ultimate victim role in which we as adults have no power when these little gray men come to us in our sleep! This is not real. The ultimate victim role is the one between an abusive parent and the victimized child.

• I don't know if these people are some sort of demons, or if they really don't exist. My daughter said she had sensors put in her body when she was small. I don't know. . . . We keep our doors locked and bolted and it really scares me. I don't have the money to send her to a good doctor, and she can't work on account of all this. . . . My daughter is hearing a voice on a tape. These go out at night and take kids and sexually abuse them. If you don't do as they say, someone in your family will be hurt. Who in their right mind would harm little children? They know everything that is said in the house. . . . Somebody

said long, long ago somebody put a curse on our family. If somebody did, how do you get the curse off? I know all this sounds strange and bizarre, but believe me it's scary.

- How many human females who had the misfortune of being raped had the foresight to take from their attacker an ID card, a picture of the rapist, or anything else which could be used as evidence as to an alleged rape?

- I for one will be sleeping with my Polaroid from now on, in hopes that the next time I'm abducted I can provide the proof needed. . . Why should it be up to the abductees to prove what's happening?

- I am living proof of Carl Sagan's claim of the possibility that alien abductions occur in the minds of people suffering from sleep paralysis. They truly believe it's real.

- In 2001 A.D. Starships from the 33 planets of the Interplanetary Confederation will land on earth carrying 33,000 Brothers! They are extraterrestrial teachers and scientists who will help to expand our understanding of interplanetary life, as our own earth planet will become the 33rd member of the Confederation!

- This is a grotesquely challenging arena. . . I studied UFOs for over 20 years. Finally I became quite disenchanted by the cult and the cult fringe groups.

- I am a 47-year-old grandmother who has been the victim of this phenomena since early childhood. I do not -- nor have I

ever -- accepted it at face value. I do not -- nor have I ever -- claimed to understand what it is. . . I would gladly accept a diagnosis of schizophrenia, or some other understood pathology, in exchange for this unknown. . . The lack of physical evidence is, I fully agree, most frustrating for both victims and researchers. Unfortunately, the retrieval of such evidence is made extremely difficult by the manner in which the victims are abducted. Often I am removed either in my nightgown (which is later removed) or already naked. This condition makes it quite impossible to hide a camera. . . I have awakened with deep gashes, puncture wounds, scooped out tissue, eye damage, bleeding from the nose and ears, burns, and finger marks and bruises which persist for days after the event. I have had all of these examined by qualified physicians but none have been satisfactorily explained. I am not into self-mutilation; these are not stigmata. . . Please be aware that the majority of abductees claim to have had no interest in UFOs previously (I am one), have no history of childhood abuses (I am one), have no desire for publicity or notoriety (I am one), and, in fact, have gone to great lengths to avoid acknowledging any involvement whatsoever, assuming he or she is experiencing a nervous breakdown or other psychological disorder (I am one). Agreed, there are many self-proclaimed abductees (and contactees) who seek out publicity for monetary gain or to satisfy a need for attention. I would be the last to deny these people exist. What

I do deny is that ALL abductees are imagining or falsifying these events to satisfy their own personal agendas.

- UFOs don't exist. I think that requires an eternal energy source, and this doesn't exist. . . I have spoken with Jesus.

- The commentary on the Parade magazine is very destructive, and it enjoys scaring society, I beg you to think more openly because our intelligent beings from outer spaces do exist and they are our creators. . . I too was an abductee. To be honest, these dear beings have done me more good than bad. They have saved my life. . . The trouble with Earth beings is that they want proof, proof, and proof!

- In the Bible it talks about terrestrial and celestial bodies. This is not to say that God is out for sexual abuse on people or that we're crazy.

- I have been strongly telepathic for twenty-seven years now. I do not receive -- I transmit. . . Waves are coming from outer space somewhere -- beaming through my head and transmitting thoughts, words, and images into the heads of anybody within range. . . Images will pop into my head that I did not put there, and vanish just as suddenly. Dreams are not dreams anymore -- they are more like Hollywood productions. . . They are smart critters and they won't give up. . . Maybe all these little guys want to do is communicate. . . If I finally go psychotic from all this pressure -- or have another heart attack -- there goes your last sure evidence that there is life in

space.

- I think I have found a plausible terrestrial scientific explanation for numerous UFO reports. [The writer then discusses ball lightning]. If you like my stuff, could you help me get it published?

- Sagan refuses to take seriously the witnesses' reports of anything that twentieth-century science can't explain.

- Now readers will feel free to treat abductees. . . as if they are victims of nothing more than an illusion. Abductees suffer the same sort of trauma a rape victim endures, and to have their experiences rejected by those closest to them is a second victimization that leaves them without any support system. Encounters with aliens is hard enough to cope with; victims need support, not rationalizations.

- My friend Frankie wants me to bring back an ashtray or a matchbook, but I think these visitors are probably much too intelligent to smoke.

- My own feeling is that the alien abduction phenomena is little more than a dreamlike sequence vicariously retrieved from memory storage. There are no more little green men or flying saucers than there are images of those things already stored in our brains.

- When alleged scientists conspire to censor and intimidate those who endeavor to offer new insightful hypotheses on conventional theories. . . they no longer should be considered

scientists, but merely the insecure, self-serving impostors that they apparently are. . . In the same token, must we also still suppose that J. Edgar Hoover was a fine FBI director, rather than the homosexual tool of organized crime he was?

- Your conclusion that large numbers of people in this country, perhaps as many as five million, are all victims of an identical mass hallucination is asinine.

- Thanks to the Supreme Court. . . America is now wide open for the Eastern pagan religions, under the aegis of Satan and his demons, so now we have four-foot gray beings kidnapping Earthlings and performing all sorts of experiments on them, and are being propagated by those who are educated beyond their intelligence and should know better. . . Your question ["Are We Being Visited?"] is no problem for those who know the word of God, and are born-again Christians, and are looking for our Redeemer from Heaven, to rapture us out of this world of sin, sickness, war, AIDS, crime, abortion, homosexuality, New-Age-New-World-Order indoctrination, media brainwashing, perversion and subversion in government, education, business, finance, society, religion, etc. Those who reject the Creator God of the Bible are bound to fall for the kind of fairy tales which your article tries to propagate as being truth.

- If there is no reason to take the matter of alien visitation seriously, why is it the most highly classified subject in the U.S. government?

- Perhaps some vastly older alien race, from a relatively metal-deficient star system, is seeking to prolong its existence by taking over a younger, better world and blending with its inhabitants.

- If I were a betting man, I would give you odds that your mailbox will overflow with stories such as I just related. I suspect that the psychic [psyche] brings forth these demons and angels, lights and circles as a part of our development. They are part of our nature.

- Science has become the "magic that works." The UFOlogists are heretics to be excommunicated or burned at the stake.

- [Several readers wrote to say that aliens were demons sent by Satan, who is able to cloud our minds. One proposes that the insidious Satanic purpose is to make us worried about an alien invasion, so that when Jesus and his angels appear over Jerusalem we will be frightened rather than glad.] I do hope you will not dismiss me, [she writes,] as another religious crackpot. I am quite normal and well-known in my own little community.

- You, sir, are in a position to do one of two things: Know about the abductions and be covering them up, or feel that because you have not been abducted (perhaps they are not interested in you) they do not occur.

- A treason suit [was filed] against the President and Congress of the United States over a treaty made with aliens in the early '40s, who had later shown themselves to be hostile. . . .

The treaty agreed to protect the secrecy of the aliens in return for some of their technology [stealth aircraft and fiber optics, another correspondent reveals].

- Some of these beings are capable of intercepting the spiritual body when it is traveling.

- I am having communication with an alien being. This communication started early in 1992. What else can I say?

- The aliens can stay a step or two ahead of the thinking of scientists, and know how to leave insufficient clues behind that would satisfy the Sagan types, until society is better prepared mentally to face up to it all. . . Perhaps you share the view that what's going on with respect to UFOs and aliens, if deemed real, would be too traumatic to think about. However. . . they've shown themselves until back some 5,000-15,000 years or more ago when they were here for extended periods, spawning the god/goddess mythology of all cultures. The bottom line is that in all that time they haven't taken over Earth; they haven't subjected us or wiped us out.

- Homo sapiens was genetically fashioned, created initially to be substitute laborers and domestics for the SKY-LORDS (DINGIRS/ELOHIM/ANUNNAKI).

- The explosion that people saw was hydrogen fuel from a star cruiser, the landing sight was to be Northern California. . . The people on that star cruiser looked like Mr. Spock from the Star Trek TV series.

- Be the reports from the 15th century or the 20th, a common thread ties the reports. Individuals who have experienced sexual trauma have a great deal of difficulty understanding and coping with the trauma. The terms used to describe the [resulting] hallucinations can be incoherent and incomprehensible.

- We find we are not as intelligent as we thought although we are still stiff-necked and our greatest sin is our pride. And we do not even know we are being led to Armageddon. The star pin-pointed a single shed, moved across the sky leading wisemen to that shed, frightened shepherds with the words Fear not. Its spotlight was Ezekiel's glory of God, Paul's light that temporarily blinded him. . . It was the ship in which little men took off old Rip, the little men called brownies, fairies, elves, these 'creations' of creators given specific duties. . . The God People are not yet ready to make themselves known to us. First, Armageddon, then, after we KNOW, we can go it alone. When we are humbled, when we do not shoot them down, God will return.

- The answer to these aliens from outer-space is simple. It comes from man. Man using drugs on people. In mental institutions all over the country, there are people who have no control over their emotions and behavior. To control these people, they are given a variety of antipsychotic drugs. . . If you have been drugged often. . . you will begin to have what is called "bleedthroughs." This will be flash images popping into your mind of strange-looking people coming up to your face. This

will begin your search for the answer of what the aliens were doing to you. You will be one of the thousands of UFO abductees. People will call you crazy. The reason for the strange creatures you are seeing is because Thorazine distorts the vision of your subconscious mind. . . The writer was laughed at, ridiculed, had his life threatened [because of presenting these ideas].

- Hypnosis prepares the mind for the invasion of demons, devils, and little gray men. God wants us to be clothed and in our right minds. . . Anything your "little gray men" can do, Christ can do better!

- I hope that I never feel so superior that I cannot acknowledge that Creation is not limited to myself, but encompasses the Universe and all its entities.

- In 1977 an heavenly being spoke to me about an injury to my head that happened in 1968.

- [A letter from a man who had 24 separate encounters with] a silent hovering saucer-shaped vehicle [and who has in consequence] experienced an ongoing development and amplification of such mental functions as clairvoyance, telepathy, and the challenging of universal life energy for the purpose of healing.

- Over the years I have seen and talked to "ghosts," been visited (though not yet abducted) by aliens, seen 3-dimensional heads floating by my bed, heard knocks on my door. . . These experiences seemed as real as life. I have never thought of these experiences as anything more than what they certainly are:

my mind playing tricks on itself.*

- A hallucination might account for 99%, but can it ever account for 100%?

- UFOs are. . . a subject of deep fantasy which has no FACTUAL BASIS WHATSOEVER. I pray you won't lend your credence to a hoax.

- Dr. Sagan served on the Air Force committee that evaluated government investigations of UFOs, and yet he wants us to believe that there's no substantial proof that UFOs exist. Please explain why the government needed to be evaluated.

- I'm going to lobby my Representative to try to cancel funds for this program of listening for alien signals from space, because it would be a waste of money. They're already among us.

- The government spends millions of tax dollars for researching UFOs. The SETI project (search for extraterrestrial intelligence) would be a waste of money if the government truly believed UFOs were nonexistent. I am personally excited about the SETI project because it shows that we're moving in the right direction; toward communication with aliens, rather than being an unwilling observer.

- The succubi, which I identified more as astral rape, occurred from '78-'92. It was hard on a moral and seriously practicing Catholic, demoralizing, dehumanizing, and quite

*From a letter received by The Skeptical Inquirer; courtesy, Kendrick Frazier.

literally had me worried by the physical aftermath of disease effects.

- The space people are coming! They hope to remove whom they can, especially children who are the 'seedlings' of the next humanity generation along with their cooperating parents, grandparents and other adults, to safety before the upcoming major sunspot/planetary peak, which is just over the horizon. The Space Ship is in sight every night and close in to assist us when the Major Solar Flares do, before turbulence starts in the atmosphere. The Polar Shift is due now as it moves to its new position for the Aquarian Age. [The authors also inform me that they are] working with the Ashtar Command, where Jesus Christ meets with those aboard for instructions. Many dignitaries are present, including archangels Michael and Gabriel.

- I have extensive experience in therapeutic energy work, which involves removing grid patterns, negative memory cords, and alien implants from human bodies and their surrounding energy fields. My work is primarily utilized as an adjunctive aide to psychotherapy. My clients range from businessmen, homemakers, professional artists, therapists, and children. . . The alien energy is very fluid, both within the body and after it is removed, and must be contained as soon as possible. The energy grids are most often locked around the heart or in a triangular formation across the shoulders.

- I don't know how, after such an experience, I could have just turned over and gone back to sleep.

- I believe in happy endings. I always have. Once you have seen a figure as tall as the room -- with golden hair, and shining like a lighted Christmas tree, lifting up the little child beside us, how could you not? I understood the message the figure was relaying -- to the little child -- and it was me. We had always talked together. How else could life be bearable -- in a place like this?. . . Unfamiliar mental states? You put your finger right on it.

- Who is really in charge of this planet?

[M, 11/28/94]

Chapter 11

THE FINE ART OF BALONEY DETECTION

The human understanding is no dry light, but receives infusion from the will and affections; whence proceed sciences which may be called "sciences as one would." For what a man had rather were true he more readily believes. Therefore he rejects difficult things from impatience of research; sober things, because they narrow hope; the deeper things of nature, from superstition; the light of experience, from arrogance and pride; things not commonly believed, out of deference to the opinion of the vulgar. Numberless in short are the ways, and sometimes imperceptible, in which the affections color and infect the understanding.

-- Francis Bacon, Novum Organon (1620)

My parents died years ago. I was very close to them. I still miss them terribly. I know I always will. I long to believe that their essence, their personalities, what I loved so much about them, are -- really and truly -- still in existence somewhere. I wouldn't ask very much, just five or ten minutes a year, say, to tell them about their grandchildren, to catch them up on the latest news, to remind them that I love them. There's a part of me -- no matter how childish it sounds -- that wonders how they are. "Is everything all right?" I want to ask. The last words I found myself saying to my father, at the moment of his death, were "Take care."

Sometimes I dream that I'm talking to my parents, and suddenly I'm seized by the overpowering realization that they didn't really die, that it's all been some kind of horrible

WTF
^ mistake. Why, here they are, alive and well, my father making jokes, my mother earnestly advising me to wear a muffler because the weather is chilly. When I wake up I go through an abbreviated process of mourning all over again. Plainly, there's something within me that's ready to believe in life after death. And it's not the least bit interested in whether there's any sober evidence for it.

So I don't guffaw at the woman who visits her husband's grave and chats him up every now and then, maybe on the anniversary of his death. It's not hard to understand. And if I have difficulties with the ontological status of who ~~it is~~ she's talking to, that's all right. That's not what this is about. This is about humans being human. Some 15 percent of Americans believe that on some level they've made contact with the dead.

But that doesn't mean I'd be willing to accept the pretensions of a "medium," who claims to channel the spirits of the dear departed, when I'm aware the practice is rife with fraud. I know how much I want to believe that my parents have just abandoned the husks of their bodies, like insects or snakes molting, and gone somewhere else. I understand that those very feelings might make me easy prey even for an unclever con. Reluctantly, I rouse some reserves of skepticism.

If some real evidence for life after death were announced, though, I'd be eager to examine it; but it would have to be hard, scientific evidence, not mere anecdote. As with the face on Mars

and alien abductions, better the hard truth, I say, than the comforting fantasy.

The fundamental premise of "channeling," as of spiritualism, is that when we die we don't. Not exactly. Some thinking, feeling, and remembering part of us continues. That whatever-it-is -- a soul or spirit, neither matter nor energy, but something else -- can, we are told, re-enter the bodies of human and other beings in the future, and so death loses much of its sting. What's more, we have an opportunity, if the spiritualist or channeling contentions are true, to make contact with loved ones who have died.

J. Z. Knight of the State of Washington claims to be in touch with a 35,000-year-old somebody called "Ramtha." He speaks English very well, using Knight's tongue and vocal chords, producing what sounds to me to be an accent from the Indian Raj. Since most people know how to talk, and many -- from children to professional actors -- have a repertoire of voices at their command, the simplest hypothesis is that Ms. Knight makes "Ramtha" speak all by herself, and that she has no contact with disembodied entities from the Pleistocene Ice Age. If there's evidence to the contrary, I'd love to hear it. It would be considerably more impressive if Ramtha could speak by himself, without the assistance of J. Z. Knight's mouth. Failing that, how might we test the claim? (The actress Shirley Maclaine attests that Ramtha was her brother in Atlantis, but that's

another story.)

Suppose Ramtha were available for questioning. Could we verify whether he is who he says he is? How does he know that he lived 35,000 years ago, even approximately? What calendar does he employ? Who is keeping track of the intervening millennia? Thirty-five thousand plus or minus what? What were things like 35,000 years ago? Either Ramtha really is 35,000 years old, in which case we discover something about that period, or he's a phony and he'll (or rather she'll) slip up.

Where on Earth did Ramtha live? (I know he speaks English with an Indian accent, but where 35,000 years ago did they do that?) What was the climate? What did Ramtha eat? (Archaeologists know something about what people ate back then.) What were the indigenous languages, and social structure? Who else did Ramtha live with -- wife, wives, children, grandchildren? What was the life cycle, the infant mortality rate, the life expectancy? Did they have birth control? What clothes did they wear? How were the clothes manufactured? What were the most dangerous predators? Hunting and fishing implements and strategies? Weapons? Endemic sexism? Xenophobia and ethnocentrism? Tell us. Give us some detail. Instead, all we are offered are banal homilies.

Here, to take another example, is a set of information channeled not from an ancient dead person, but from unknown non-human entities who make crop circles, as recorded by the

journalist Jim Schnabel:

We are so anxious at this sinful nation spreading lies about us. We do not come in machines, we do not land on your earth in machines. . . We come like the wind. We are Life Force. Life Force from the ground. . . Come here. . . We are but a breath away. . . a breath away. . . we are not a million miles away. . . a Life Force that is larger than the energies in your body. But we meet at a higher level of life. . . We need no name. We are parallel to your world, alongside your world. . . The walls are broken. Two men will rise from the past. . . the great bear. . . the world will be at peace.

People pay attention to these puerile marvels mainly because they promise something like old-time religion, but especially life after death, even life eternal.

A 1994 book by the Tulane University physicist Frank Tipler promises life after death for all of us and our bodily resurrection. But the argument is based on computers of the future being fed the information in our DNA. Those of us who neglect to preserve our nucleic acids for future generations are out of luck. A skeptic might also harbor doubts about the ability of scientists of the future to reconstruct all the information we have learned since conception, which surely plays a fundamental role in determining who we are. In my 1985 novel Contact, I had a character who ejects himself, frozen to 3° above absolute zero, into interstellar space in a small capsule packed with personal memorabilia, so he might be resurrected by some advanced interstellar civilization in the far future. But that was intended as fiction.

A very different prospect for something like eternal life was once proposed by the versatile British scientist J. B. S. Haldane, who was, among many other things, one of the founders of population genetics. Haldane imagined a far future when the stars have darkened and space is mainly filled with a cold, thin gas. Nevertheless, if we wait long enough statistical fluctuations in the density of this gas will occur. Over immense periods of time the fluctuations will be sufficient to reconstitute a Universe something like our own. If the Universe is infinitely old, there will be an infinite number of such reconstitutions, Haldane pointed out.

So in an infinitely old universe with an infinite number of appearances of galaxies, stars, planets, and life, an identical Earth must reappear on which you and all your loved ones will be reunited. I'll be able to see my parents again and introduce them to the grandchildren they never knew. And all this will happen not once, but an infinite number of times.

Somehow, though, this does not quite offer the consolations of religion. If none of us is to have any recollection of what happened this time around, the time the reader and I are sharing, the satisfactions of bodily resurrection, in my ears at least, ring hollow.

But in this reflection I have underestimated what infinity means. There will be universes, indeed an infinite number of them, in which our brains will have full recollection of all

previous rounds. Consolation is at hand -- tempered, though, by the thought of all those other universes which will also come into existence (again, not once but an infinite number of times) with tragedies and horrors vastly outstripping anything I've experienced this turn.

All of this depends, though, on what kind of universe we live in, whether there's enough matter to eventually reverse the expansion of the universe, and the character of vacuum fluctuations. Those with a deep longing for life after death might, it seems, devote themselves to cosmology, quantum gravity, and elementary particle physics.

* * *

Clement of Alexandria, a Father of the early Church, in his Exhortations to the Greeks (ca. 190 A.D.) dismissed pagan beliefs in words that might today seem a little ironic:

Far indeed are we from allowing grown men to listen to such tales. Even to our own children, when they are crying their heart out, as the saying goes, we are not in the habit of telling fabulous stories to soothe them.

In our time we have less severe standards. We tell children about Santa Claus, the Easter Bunny, and the Tooth Fairy for reasons we think emotionally sound, but then disabuse them of these myths before they're grown. Why retract? Because their well-being as adults depends on them knowing the world as it really is. We worry, and for good reason, about adults who still

And of course they do not tell us of the hundreds [check] of deaths each year from the use of aspirin, or the roughly 5,000 cases of kidney failure from the use of acetaminophen, chiefly Tylenol.

["The Fine Art of Baloney Detection" (M, 11/28/94)]

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believe in Santa Claus.

On doctrinaire religions, "Men dare not avow, even to their own hearts," wrote the philosopher David Hume,

the doubts which they entertain on such subjects. They make a merit of implicit faith; and disguise to themselves their real infidelity, by the strongest asseverations and the most positive bigotry.

This infidelity has profound moral consequences, as the American revolutionary Tom Paine wrote in The Age of Reason:

Infidelity does not consist in believing, or in disbelieving; it consists in professing to believe what one does not believe. It is impossible to calculate the moral mischief, if I may so express it, that mental lying has produced in society. When man has so far corrupted and prostituted the chastity of his mind, as to subscribe his professional belief to things he does not believe, he has prepared himself for the commission of every other crime.

There is a class of aspirin commercials in which actors pretending to be doctors reveal the competing product to have only so much of the painkilling ingredient that doctors recommend most -- they don't tell you what the mysterious ingredient is. Whereas their product has a dramatically larger amount (1.2 to 2 times more per tablet). So buy their product. But why not just take two of the competing tablets? Or consider the analgesic that works better than the "regular-strength" product of the competition. Why not then take the "extra-strength" competitive product? Or who cares which breakfast cereal has more vitamins when we can take a vitamin pill with breakfast? Likewise, why should it matter whether an antacid contains calcium if the calcium is for nutrition and irrelevant for gastritis?

Commercial culture is full of ^{similar} such misdirections and evasions at the expense of the consumer. You're not supposed to ask. Don't think. Buy.

Such claims constitute a steady rainfall of ~~small~~ deceptions, ^{although} ~~although~~ ^{They} they betray contempt for the intelligence of their customers, ^{And} ~~and~~ ^a introduce an insidious corruption of popular attitudes about scientific objectivity. ^{many} As Tom Paine warned, inuring us to lies lays the groundwork for ~~all~~ ^{one of the annual} other evils.

I have in front of me as I write the program of ~~the~~ ^{one of the annual} Whole Life Expo, ~~an annual~~ New Age exposition, ^{of} held in San Francisco. Typically, tens of thousands of people attend. Here are some of the presentations: "How Trapped Blood Proteins Produce Pain and Suffering." "Crystals, Are They Talismans or Stones?" (I have an opinion myself.) It continues: "As a crystal focuses sound and light waves for radio and television" -- ^{this is a misunderstanding} ~~crystal sets were~~ ^{of how radio and television work} ~~rather a long time ago~~ -- "so may it amplify spiritual vibrations for the attuned human." Or here's one: "Return of the Goddess, a Presentational Ritual." Another: "Synchronicity, the Recognition Experience." That one is given by "Brother Charles." Or, on the next page, "You, Saint-Germain, and Healing Through the Violet Flame." It goes on and on, with plenty of ads about "opportunities" -- ranging from the dubious to the spurious -- that are available at the Whole Life Expo. Of course similarly improbable miracles and cures are offered by more conventional religions worldwide.

Distraught cancer victims make pilgrimages to the Philippines, where "psychic surgeons," having palmed bits of chicken liver or goat heart, pretend to reach into the patient's innards and withdraw the diseased tissue, which is then triumphantly displayed. Leaders of Western democracies regularly consult astrologers and mystics before making decisions of state. Under public pressure for results, police with an unsolved murder or a missing body on their hands consult ESP "experts" (who never guess better than expected by common sense, but the police, the ESPers say, keep calling). A clairvoyance gap with adversary nations is announced, and the Central Intelligence Agency, under Congressional prodding, spends tax money to find out whether submarines in the ocean depths can be located by thinking hard at them. A "psychic" -- using pendulums over maps and dowsing rods in airplanes -- purports to find new mineral deposits; an Australian mining company pays him top dollar up front, none of it returnable in the event of failure, and a share in the exploitation of ores in the event of success. Nothing is discovered. Statues of Jesus or murals of Mary are spotted with moisture, and thousands of kind-hearted people convince themselves that they have witnessed a miracle.

These are all cases of proved or presumptive baloney. A deception arises, sometimes ^{'innocently but} collaboratively, sometimes with cynical premeditation. Usually the victim is caught up in a powerful emotion -- wonder, fear, greed, grief. Credulous

acceptance of baloney can cost you money; that's what P. T. Barnum meant when he said, "There's a sucker born every minute." But it can be much more dangerous than that, and when governments and societies lose the capacity for critical thinking, the results can be catastrophic -- however sympathetic we may be to those who have bought the baloney.

In the course of their training, scientists are equipped with a baloney detection kit. The kit is brought out as a matter of course whenever new ideas are offered for consideration. If the new idea survives examination by the tools in our kit, we grant it warm, although tentative, acceptance. If you're so inclined, if you don't want to buy baloney even when it's reassuring to do so, there are precautions that can be taken; there's a tried-and-true, consumer-tested method that permits you to distinguish beef from baloney.

What's in the kit? Tools for skeptical thinking.

What skeptical thinking boils down to is the means to construct, and to understand, a reasoned argument and -- especially important -- to recognize a fallacious or fraudulent argument. The question is not whether we like the conclusion that emerges out of a train of reasoning, but whether the conclusion follows from the premise or starting point and whether that premise is valid.

Among the tools:

- There must be substantive debate on the evidence by knowledgeable proponents of all points of view. It isn't enough simply to attack your opponent's character or vested interests.

- Arguments from authority carry little weight -- "authorities" have made mistakes in the past. They will do so again in the future. Perhaps a better way to say it is that in science there are no authorities; at most, there are experts.

- Spin more than one hypothesis. If there's something to be explained, think of all the different ways in which it could be explained. Then think of tests by which you might systematically disprove each of the alternatives. What survives in this Darwinian process of "multiple working hypotheses," the hypothesis that resists disproof, has a much better chance of being the right answer than if you had simply run with the first idea that caught your fancy.

- Try not to get overly attached to a hypothesis just because it's yours. You may have created it, but it's not a child. It's only a way-station in the pursuit of knowledge. Be as skeptical as possible toward it. Compare it fairly with the alternatives. See if you can find reasons for rejecting it. If you don't, others will.

- Quantify. If whatever it is you're explaining has some measure, some numerical quantity attached to it, you'll be much better able to discriminate among competing hypotheses. What is vague and qualitative is open to many explanations.

* Forrest Quinn R

[12-11-94.at1]

Dumont R, Ch 11, p.12

An insert into The Demon-Haunted World:

- * This is a problem that affects jury trials. *Retrospective studies show that* Some jurors make up their minds very early -- perhaps *during* ~~at~~ the time of the opening arguments -- and then retain the evidence that seems to support their initial impressions and reject the contrary evidence. The method of alternative working hypotheses is not running in their heads. [Reference: Daniel Goleman, "Study Finds Jurors Often Hear Evidence with a Closed Mind," New York Times, November 29, 1994, pp. C-1, C-12.]

Bob: to refs. in back

(Always ask whether the hypothesis can be, at least in principle, falsified)

["The Fine Art of Baloney Detection" (M, 11/28/94)]

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- If there ^{is} ~~is~~ a chain of argument, every link in the chain must work (including the premise) -- not just most of them.
- Propositions that are ~~not~~ ^{un} testable ^{unfalsifiable} are worthless. You must be able to check assertions out. Inveterate skeptics must be given the chance to duplicate experiments and see if they get the same result.

The reliance on carefully designed and controlled experiments is key, as I tried to stress earlier. We will not learn much from mere contemplation. Some of us may be content with the first candidate explanation we can think of. One is much better than none. But what happens if we can invent several? How do we decide among them? We don't. We let ~~the~~ ^{experiment} ~~natural world~~ do it. Francis Bacon provided the classic reason: ~~for experimentation.~~

Argumentation cannot suffice for the discovery of new work, since the subtlety of Nature is greater many times than the subtlety of argument.

Control experiments are essential. If, for example, a new medicine is alleged to cure a disease 20 percent of the time, we must make sure that ~~a~~ ^{the subjects} control population, taking a placebo sugar pill ~~instead of~~ ^{which for all it knows might be} the new drug, does not also experience spontaneous remission of the disease 20 percent of the time.

Variables must be separated. If you're seasick and given both an acupressure bracelet and ^{50 milligrams of} ~~a~~ meclizine ~~{check} pill~~ and find the discomfort vanishes, what did it -- the bracelet or the pill? You can tell only if you take the one without the other,

next time you're seasick. (Now imagine that you're not so dedicated to science as to be willing to be seasick. Then you won't separate the variables. You'll take both remedies again. You've achieved the desired practical result; further knowledge, you might say, is not worth the discomfort of attaining it.)

Often the experiment must be done "double-blind," so that those hoping for a certain finding are not in the potentially compromising position of evaluating the results. In testing a new medicine, for example, you might want the physicians who determine which patients' symptoms are relieved not to know which patients have been given the new drug. The knowledge might influence their decision, even if only unconsciously. Instead the list of those who ^{experienced} ~~have~~ remission of symptoms can be compared with the list of those who got the new drug, each independently ascertained. Then you can determine ^{what} ~~whether a striking~~ correlation exists.

Many institutions are ^{eager} ~~willing~~ to be associated with the cachet of science, but not to risk its scrutiny. I remember being called by a former science editor for a major metropolitan newspaper, now reduced to public relations -- a gun for hire. A suit had been filed claiming that cellular telephones could cause brain cancer -- the electromagnetic waves somehow focused just above the ear. The negative publicity, the industry feared, might impact sales.

How should the companies' denial be phrased? he wanted to know.

How do you know the claim is false? I asked him.

False? The thought had never occurred to him.

Well, I suggested, ask the manufacturers to sponsor a scientific study, with appropriate controls, and determine if their product is dangerous or not.

Yes, he wanted to know, but how could the cellular telephone industry control the outcome of the study?

Patiently I tried to explain: If the companies could control the outcome of the study, then the effort would be worthless. The whole idea was to sponsor a study that the companies could not control -- done by the National Academy of Sciences, for example.

Eventually, this is what was done. (The suggestion is so obvious that I do not imagine it was my urging that brought it about.) Cellular phones were ^{tentatively} cleared of complicity in brain cancer. The suits, based on a very small number of instances when users of cellular telephones got ^{unusual} brain cancer^s, were withdrawn or dismissed. What sticks in my brain is the former science editor, now shilling for corporations, and apparently devoid of any vestige of understanding that the impartiality of science is its strength. The American tobacco industry grosses some \$50 billion per year.

There is a statistical correlation between smoking and cancer, the tobacco industry admits, but not, they say, a causal

relation. What might this mean? Maybe people with hereditary propensities for cancer also have hereditary propensities to take addictive drugs -- so cancer and smoking might be correlated, but the cancer would not be caused by the smoking (or vice versa). Increasingly far-fetched connections of this sort can be contrived. This is exactly one of the reasons science insists on control experiments.

Suppose you paint the backs of large numbers of rats with cigarette tar, and also follow the health of large numbers of nearly identical rats that have not been painted. If the former get cancer and the latter do not, you can be pretty sure that the correlation is causal. Inhale tobacco smoke, and the chance of getting cancer goes up; don't inhale, and the rate stays at the background level. Likewise for emphysema, bronchitis, and cardiovascular diseases.

When the first work was published in the scientific literature in 1953 showing that the substances in cigarette smoke when painted on the backs of rodents produced malignancies, the response of the six major tobacco companies was ~~to initiate~~ a public relations campaign to impugn the research of the Sloan Kettering Foundation. This is similar to what the Du Pont Corporation did when the first research was published in 1974 showing that their Freon product attacks the protective ozone layer. There are many other examples.

You might think that before they denounce unwelcome research findings, major corporations would devote their considerable resources to checking out the safety of the products they propose to manufacture. And if they missed something, if independent scientists suggest a hazard, why would the companies protest? Would they rather kill people than lose profits? If, in an uncertain world, an error must be made, shouldn't it be biased toward protecting customers and the public? And, incidentally, what do these cases say about the ability of the free enterprise system to police itself? Are ^{n't} these instances where government intrusion is ~~not~~ in the public interest?

A 1971 internal report of the Brown and Williamson Tobacco Corporation lists as a corporate objective "to set aside in the minds of millions the false conviction that cigarette smoking causes lung cancer and other diseases; a conviction based on fanatical assumptions, fallacious rumors, unsupported claims and the unscientific statements and conjectures of publicity-seeking opportunists." They complain of

the incredible, unprecedented and nefarious attack against the cigarette, constituting the greatest libel and slander ever perpetrated against any product in the history of free enterprise; a criminal libel of such major proportions and implications that one wonders how such a crusade of calumny can be reconciled under the Constitution can be so flouted and violated [sic].

This rhetoric is only slightly more inflamed than what the tobacco industry has from time to time uttered for public consumption.

There are many brands of cigarettes that advertise low ^{Ca few milligrams per cigarette).} "tar". Why is this a virtue? Because it is the refractory tars in which polycyclic aromatic hydrocarbons and some other carcinogens are concentrated. Aren't the low tar ads a tacit admission by the tobacco companies that cigarettes indeed cause cancer?

Tobacco is addictive; by ^{many} ~~some~~ criteria it is in the same league as heroin and cocaine. According to the World Health Organization, smoking kills three million people every year worldwide. This will rise to ten million annual deaths by 2020. Part of the success of the tobacco industry in purveying this brew of addictive poisons can be attributed to widespread ^{and the scientific method} unfamiliarity with critical thinking. Gullibility kills.

-- in part because of a massive ~~can~~ advertising campaign to portray smoking as advanced and fashionable to ^{young} women in the developing world. * * *

In addition to teaching us what to do when evaluating a claim to knowledge, any good baloney detection kit must also teach us what not to do. It helps us recognize the most common and perilous fallacies of logic and rhetoric. Among these are:

- ad hominem -- Latin for "to the man," attacking the arguer and not the argument (e.g., The Reverend Dr. Smith is a known Biblical fundamentalist, so her objections to evolution need not be taken seriously);

- appeal to ignorance (or, as I like to put it, absence of evidence is not evidence of absence) (e.g., There is no compelling evidence that UFOs are visiting the Earth; therefore there is no intelligent life anywhere else in the Universe);

- arguments from authority (e.g., President Richard Nixon's suggestion that he be re-elected because he had a secret plan to end the war in Southeast Asia -- but because it was secret, there was no way for us to evaluate it on its merits; the argument amounted to trusting him because he was President: a mistake, as it turned out);

- begging the question (e.g., The stock market fell yesterday because of a technical adjustment and profit-taking by investors -- but is there any independent evidence for ~~the~~ the causal role

of this purported explanation?
"adjustment" and profit-taking; *have we learned anything at all from* ~~and (2) their purported causal role?~~ Or: We must institute the death penalty to discourage violent crime. But does the violent crime rate in fact fall when the death penalty is instituted?);

- observational selection, *also called* ~~or~~ the enumeration of favorable circumstances, or counting the hits and forgetting the misses*

*My favorite example is this story, told about the Italian physicist Enrico Fermi, newly arrived on American shores, enlisted in the Manhattan nuclear weapons Project, and brought face-to-face in the midst of the Second World War with U.S. flag officers.

So-and-so is a great general, he was told.
What is the definition of a great general? Fermi characteristically asked.
I guess it's a general who's won many consecutive battles.
How many?
After some back and forth, they settled on five.
What fraction of American generals are great?

Or: be comfortable about the ^{near} social collapse in the former Soviet Union as a "price" of transition, but be opposed to affirmative action ^{in America} and ~~women's feminist politics~~ as another price of transition.

["The Fine Art of Baloney Detection" (M, 11/28/94)]

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(e.g., Ms. Jones is a remarkable psychic, but she has to be in the right mood. Most days her scores are just average. Or: A state boasts of the Presidents it has produced, but is silent on its mass murderers);

• false alternative (e.g., Sure, my husband's perfect; I'm always wrong. Or: If scientists claim there's a hereditary predisposition for men to rape and murder, then they're ^{giving} providing ^{men} excuses for men to rape and murder);

• short-term vs. long-term -- this is a subset of the false alternative, but so important I've pulled it out for special attention (e.g., We can't afford programs to feed malnourished children, educate pre-school kids, and keep teenagers out of trouble. Our society has more urgent things to do);

• inconsistency (e.g., ^P prudently plan for the worst of which a potential military adversary is capable, but thriftily ignore scientific projections on environmental dangers because they're not "proved");

• non sequitur -- Latin for "It doesn't follow" (e.g., Our nation will prevail because God is great);

After some more back and forth, they settled on a few percent.

But imagine, Fermi rejoined, that there is no such thing as a great general, that all armies are equally matched, and that winning a battle is purely a matter of chance. Then the chance of winning one battle is one out of two, or $1/2$; two battles $1/4$, three $1/8$, four $1/16$, and five consecutive battles $1/32$ -- or about three percent. You would expect a few percent of American generals to win five consecutive battles purely by chance. Has any of them won ten consecutive battles. . .?

- meaningless question (e.g., what happens when an irresistible force meets an immovable object?);

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- unexamined premise (ditto);

• post hoc, ergo propter hoc -- Latin for "It happened after, so it was caused by" (e.g., The President's wise economic policies are responsible for the upturn in the market -- but often those policies were instituted too late to influence the current market statistics, or the improvement is within the statistical error of the ordinary fluctuations in economic indicators);

• slippery slope (e.g., if ~~you prohibit abusive, obnoxious speech that reviles one or another ethnic group, you open the opportunity for the government to suppress any opinions it doesn't like~~; ^{we allow abortion in the first weeks of pregnancy, it will be possible to prevent the killing of a full-term infant; or, conversely if ~~we permit the state to prohibit abortion even in the ninth month~~ it will be telling us what to do with our bodies ~~at conception~~});

• confusion of correlation and causality (e.g., A survey shows that college graduates are more likely to be homosexual than those with lesser education; therefore education makes people gay. Or: Andean earthquakes are correlated with oppositions of the planet Uranus; therefore -- despite the absence of any such correlation for the nearer, more massive planet Jupiter -- the latter causes the former);

• statistics of small numbers (e.g., My friend swears by this herb infusion; her arthritis has almost disappeared. But sometimes the body cures an illness all by itself. Has the infusion been tried often enough, on enough different people, ^{for us to be} that we're confident that spontaneous remissions have been averaged out?);

* Quoted from p. 213

• straw man -- ~~weakening and~~ caricaturing a position to make it easier to attack (e.g., Scientists suppose that the first living things simply fell together by chance. Or: Environmentalists care more for snail darters and spotted owls than they do for people);

• suppressed evidence, or half-truths (e.g., an amazingly accurate and widely quoted ^{"prophecy"} ~~"prediction"~~ of the assassination attempt on President Reagan is made on television; but was it recorded before or after the event? Or: ^{-- an important detail --} a commercial tells us that "doctors say" a certain remedy ^{is preferable} ~~works~~, but viewers are shielded from the fact that other doctors, perhaps a vast majority of them, disagree); ^{are potentially powerful tools in getting themselves}

• weasel words (e.g., The separation of powers of the U.S. Constitution specifies that the United States may not conduct a war without a declaration by Congress. On the other hand, Presidents are given control of foreign policy and the conduct of wars, which ~~can be used to help them get re-elected~~ ^{may be tempted to} Presidents therefore ~~have an interest in~~ ^{waving the flag and} arranging wars while calling them something else -- "police actions," "armed incursions," "protective reaction strikes," "pacification," "safeguarding American interests," and a wide variety of "operations," such as "Operation Just Cause." Euphemisms for war are ~~just~~ one of a broad class of reinventions of language for political purposes. Talleyrand said, "An important art of politicians is to find new names for institutions which under old names have become odious

to the public").

Knowing the existence of such logical and rhetorical fallacies rounds out our toolkit. Like all tools, the baloney detection kit can be misused, applied out of context, or even employed as a rote alternative to thinking. But used judiciously, it can make all the difference in the world -- not least in evaluating our own arguments before we present them to others.

Top 21: * Or: Children who watch violent TV programs ^{tend} ~~grow~~ up to be more violent when they grow up. But did the TV cause the violence, or do violent children ^{preferentially} enjoy watching violent programs? Very likely ~~the causality~~ both are true. Defenders of TV violence argue that anyone can distinguish between television and reality. But Saturday morning children's programs now average 25 acts of violence per hour. At the very least this desensitizes young children to aggression and random cruelty. And if impressionable people can have false memories implanted in their brains, what are we implanting ^{in our children} with ~~television violence?~~ when we expose them to some 100,000 acts of violence before they graduate from elementary school?

NEW REF?

W.K. Clifford epigram from
pp. 400-401, Philosophy of Religion

[M, 11/28/94]

Chapter 12

OBSESSED WITH REALITY

~~Epigraph to come~~

→ Ch 20

We also know how cruel the truth often is, and we wonder whether delusion is not more consoling.

-- Henri Poincaré (1854-1912)

At the borders of science -- and sometimes as a carry-over from prescientific thinking -- lurks a range of ideas that are appealing, or at least modestly mind-boggling, but that ~~their~~^{been} advocates have not conscientiously worked over with a baloney, at least by their advocates: detection kit, the notion, say, that the Earth's surface is on the inside, not the outside, of a sphere; or claims that you can levitate yourself by meditating and that ballet dancers and basketball players routinely levitate; or the proposition that I have something called a soul, made not of matter or energy, but of something else for which there is no other evidence, and which after my death might return to animate a cow or a worm; or the conviction that some people have the "psychic" power to bend spoons or curdle milk by looking funny at them.

Other typical offerings of pseudoscience are astrology; the Bermuda Triangle; "Big Foot" and the Loch Ness monster; ghosts; the "evil eye"; multi-colored halo-like "auras" said to surround the heads of everyone (with personalized colors); extrasensory perception (ESP), such as telepathy, precognition, telekinesis, and "remote viewing" of distant places; the belief that 13 is an

Fashionable in earlier epochs, accomplished by viewing
Can the Divinations ~~of~~ ^{from} shadows and excrement; ~~the~~ ^{the} sounds of gurgling stomachs; and even, briefly, from tables of logarithms); ~~through~~ ^{entrails, smoke, the shapes of flames,}

["Obsessed with Reality" (M, 11/28/94)]

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"unlucky" number (because of which many no-nonsense office buildings and hotels pass directly from the 12th to the 14th floors -- why take chances?); the conviction that carrying the severed foot of a rabbit around with you brings good luck; divining rods and water witching; "facilitated communication" in autism; the belief that razor blades stay sharper when kept inside small cardboard pyramids, and other tenets of "pyramidology"; phone calls (none of them collect) from the dead; the prophecies of Nostradamus; the alleged discovery that untrained flatworms can learn a task by eating the ground-up remains of other, better educated flatworms; the notion that more crimes are committed when the Moon is full; palmistry; numerology; polygraphy; comets, tea leaves, ~~entrails~~, and "monstrous" births as prodigies of future events; "photography" of past events, such as the crucifixion of Jesus; a Russian elephant that speaks fluently and a Russian "sensitive" who, blindfolded, reads books with her fingertips; Edgar Cayce (who predicted that the "lost" continent of Atlantis would "rise" in the 1960s) and other "prophets," sleeping and awake; diet quackery; out-of-body (e.g., near-death) experiences interpreted as real events in the external world; ancient maps of Antarctica; faith-healer fraud; the emotional lives of geraniums, uncovered by intrepid use of a "lie detector"; ~~fire walking~~; water remembering what molecules used to be dissolved in it; phrenology; the "hundredth monkey" confusion and other claims

that whatever a small fraction of us wants to be true really is true; human beings spontaneously bursting into flame and being burned to a crisp; much of biorhythms; perpetual motion machines, promising unlimited supplies of energy (but ^{all of} which, for one reason or another, are withheld from close examination by skeptics); the systematically inept predictions of Jeanne Dixon and other professional "psychics"; dianetics and Scientology; Carlos Castaneda and "sorcery"; claims of finding the remains of Noah's Ark; the "Amityville Horror" and other hauntings; and accounts of a small brontosaurus in our time crashing through the rain forests of the Congo Republic.

Some claims are hard to test -- for example, if an expedition fails to find the ghost or the brontosaurus, that doesn't mean it doesn't exist. Others are easier -- for example, flatworm cannibalistic learning or the announcement that colonies of bacteria subjected to an antibiotic on an agar dish thrive when their prosperity is prayed for (compared to control bacteria unredeemed by prayer). A few -- for example, perpetual motion machines -- can be excluded on grounds of fundamental physics. Except for these few, it's not that we know before examining the evidence that the notions are false; stranger things are routinely incorporated into the corpus of science.

The question, as always, is how good is the evidence? Revealingly, some proponents of these ideas hold that skepticism is a liability, that true science is inquiry without skepticism.

They are perhaps halfway there. But halfway doesn't do it.

Parapsychologist Susan Blackmore describes one of the steps in her transformation to a more skeptical attitude on "psychic" phenomena:

A mother and daughter from Scotland asserted they could pick up images from each other's minds. They chose to use playing cards for the tests because that is what they used at home. I let them choose the room in which they would be tested and insured that there was no normal way for the "receiver" to see the cards. They failed. They could not get more right than chance predicted and they were terribly disappointed. They had honestly believed they could do it and I began to see how easy it is to be fooled by your own desire to believe.

I had similar experiences with several dowzers, children who claimed they could move objects psychokinetically, and several who said they had telepathic powers. They all failed. Even now I have a five-digit number, a word, and a small object in my kitchen at home. The place and items were chosen by a young man who intends to "see" them while traveling out of his body. They have been there (though regularly changed) for three years. So far, though, he has had no success.

Telepathy literally means to feel at a distance -- just as telephone is to hear at a distance and television is to see at a distance. The word suggests the communication not of thoughts but of feelings. Around a quarter of all Americans believe they've experienced something like telepathy. People who know each other very well, who live together, who are practiced in one another's feeling tones, associations, and thinking styles can often anticipate what the partner will say. This is merely the usual five senses plus human empathy, sensitivity, and intelligence in operation. It may feel extrasensory, but it's not at all what's intended by the word "telepathy."

It is barely possible that a few of these paranormal claims might one day be verified by solid scientific data. But it would be foolish to accept any of them in the absence of adequate evidence. Much better, for those claims not already disproved or adequately explained prosaically, is to contain our impatience, to nurture a tolerance for ambiguity, and to await -- or, much better, to seek -- supporting or disconfirming evidence.

* * *

[Italicized:]

In a far-off land in the South Seas, the word went out about a wise man, a healer, an embodied spirit. He could speak across time. He was an Ascended Master. He was coming, they said. He was coming. . . [End italics.]

In 1988, Australian newspapers, magazines, and television stations began to receive the good news via press kits and videotape. One broadside read:

CARLOS

TO APPEAR IN AUSTRALIA

Those who have seen it will never forget. The brilliant young artist who has been talking to them suddenly seems to falter, his pulse slows dangerously and virtually stops at the point of death. The qualified medical attendant, who has been assigned to keep constant watch, is about to sound the alarm.

But then, with a heart-stirring burst, the pulse is felt again -- faster and stronger than ever before. The life force clearly has returned to the body -- but the entity inside that body is no longer Jose Luis Alvarez, the 19-year-old whose unique

painted ceramics are featured in some of the wealthiest homes in America. Instead, the body has been taken over by Carlos, an ancient soul, whose teachings will come as both a shock and an inspiration. One being going through a form of death to make way for another: that is the phenomenon that has made Carlos, as channelled through Jose Luis Alvarez, the dominant new figure in New Age consciousness. As even one sceptical New York critic puts it: "The first and only case of a channeller offering tangible, physical proof of some mysterious change within his human physiology."

Now Jose, who has gone through more than 170 of these little deaths and transformations, has been told by Carlos to visit Australia -- in the words of the Master, "the old new land" which is to be the source of a special revelation. Carlos already has foretold that in 1988 catastrophes will sweep the earth, two major world leaders will die and, later in the year, Australians will be among the first to see the rising of a great star which will deeply influence future life on earth.

SUNDAY 21ST

-- 3 PM --

OPERA HOUSE

DRAMA THEATRE

Following a 1986 motorcycle accident, the press kit explained, Jose Alvarez -- a [TK]-year-old ceramic artist -- suffered a mild concussion. After he recovered, those who knew him could tell that he had changed. A very different voice sometimes emanated from him. Bewildered, Alvarez sought help from a psychotherapist who specialized in multiple personality disorders. The psychiatrist "discovered that Jose was channelling a distinct entity who was known as Carlos. This entity takes over the body of Alvarez when the body's life force is relaxed to the right degree." Carlos, it turns out, is a two-thousand-year-old spirit disincarnate, a ghost without bodily

form, who last invaded a human body in Caracas, Venezuela in 1900. Unfortunately, that body died at age 12 in a fall from a horse. This may be why, the therapist explained, Carlos could enter Alvarez's body following the motorcycle accident. When Alvarez goes into his trance, the spirit of Carlos, focused by a large and rare crystal, enters him and utters the wisdom of the ages.

Included in the press kit was a list of major appearances in American cities, a videotape of the tumultuous reception that Alvarez/Carlos received at a Broadway theater, his interview on New York radio station WOOP, and other indications that here was a formidable American New Age phenomenon. Two small substantiating details: An article from a South Florida newspaper read, "THEATER NOTE: The three-day stay of channeler CARLOS has been extended at the War Memorial Auditorium. . . in response to the requests for further appearances," and an excerpt from a television program guide listed a special on "THE ENTITY CARLOS: This in-depth study reveals the facts behind one of today's most popular and controversial personalities."

Alvarez and his manager arrived in Sydney first class on Qantas. They travelled everywhere in an enormous white stretch limousine. They occupied the Presidential Suite of one of the city's most prestigious hotels. Alvarez wore an elegant white gown with a golden medallion. In his first press conference, Carlos quickly emerged. The entity was forceful, literate,

commanding. Australian television quickly lined up for appearances by Alvarez, his manager, and his nurse (to check his pulse and announce the presence of Carlos).

On Australia's Today Show, they were interviewed by the host, George Negus. When Negus posed a few reasonable and skeptical questions, the New Agers exhibited very thin skins. Carlos laid a curse on the anchorman. His manager doused Negus with a glass of water. Both stalked off the set. It was a sensation in the tabloid press, its significance rehashed on Australian television. "TV Outburst: Water Thrown at Negus," was the front-page headline in the February 16, 1988 Daily Mirror. Television stations were flooded with calls. One Sydney citizen advised taking the curse on Negus very seriously: The army of Satan had already taken over the United Nations, he said, and Australia might be next.

Carlos' next appearance was on the Australian version of A Current Affair. A skeptic was brought in who described a magician's trick by which the pulse in one hand is made briefly to stop: You put a rubber ball in your armpit and squeeze. When Carlos' authenticity was questioned, he was outraged: "This interview is terminated!" he thundered.

On the appointed day, the Drama Theatre of the Sydney Opera House was nearly filled. An excited crowd, young and old, milled about expectantly. Entrance was free -- which reassured those who vaguely wondered if it might be some sort of scam. Alvarez

seated himself on a low couch. His pulse was monitored. Suddenly it stopped. Seemingly, he was near death. Low, guttural noises emanated from deep within him. The audience gasped in wonder and awe. Suddenly, Alvarez's body took on power. His posture radiated confidence. A broad, humane, spiritual perspective flowed out of Alvarez's mouth. Carlos was here! Interviewed afterwards, many members of the audience described how they had been moved and delighted.

The following Sunday, Australia's most popular TV program -- named Sixty Minutes after its American counterpart -- revealed that the Carlos affair was a hoax, front to back. The producers thought it would be instructive to explore how easily a faith healer or guru could be created to bamboozle the public and the media. So naturally, they contacted one of the world's leading experts (at least among those not currently holding or advising elective office) on deceiving the public -- the magician James Randi.

* * *

"[T]here being so many disorders which cure themselves and such a disposition in mankind to deceive themselves and one another;" -- wrote Benjamin Franklin in 1784 --

. . . and living long having given me frequent opportunities of seeing certain remedies cried up as curing everything, and yet soon after totally laid aside as useless, I cannot but fear that the expectation of great advantage from the new method of treating diseases will prove a delusion. That

delusion may however in some cases be of use while it lasts. He was referring to mesmerism. But "every age has its peculiar folly."

Unlike Franklin, most scientists feel it's not their job to expose pseudoscientific bamboozles -- much less, passionately held self-deceptions. They tend not to be very good at it. Scientists are used to struggling with Nature, who may surrender her secrets reluctantly but who fights fair. Often they are unprepared for those unscrupulous practitioners of the "paranormal" who play by different rules. Magicians, on the other hand, are in the deception business. They practice one of the many occupations -- like acting, advertising, bureaucratic religion, and politics -- where what a naive observer might misunderstand as lying is socially condoned as in the service of a higher good. Many magicians pretend they don't cheat, and hint at powers conferred by mystic sources or, lately, by alien largesse. Some use their knowledge to expose charlatans in and out of their ranks. A thief is set to catch a thief.

Few rise to this challenge as energetically as James "The Amazing" Randi, accurately self-described as an angry man. He is angry not so much about the survival into our day of antediluvian mysticism and superstition, but about how uncritical acceptance of mysticism and superstition works to defraud, to humiliate, and sometimes even to kill. Like all of us, he is imperfect: Sometimes Randi is intolerant and condescending, nearly oblivious

He demonstrated the simple deceptions and misdirections by which psychic spoonbenders had ~~taken~~^{conned} prominent theoretical physicists into deducing new physical phenomena.

["Obsessed with Reality" (M, 11/28/94)]

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of the human roots behind credulity. He is routinely paid for his speeches and performances, but nothing compared to what he could receive if he declared his deceptions to derive from psychic powers or divine or extraterrestrial influences. (Most professional conjurors, worldwide, seem to believe in the reality of psychic phenomena -- according to polls of their views.) As a conjuror, he has done much to expose ~~spoonbenders~~^{not}, remote viewers, "telepaths," ~~and~~^{not} faith healers who have bilked the public. He has received wide recognition among scientists and is a recipient of the MacArthur Foundation (so-called "genius") Prize Fellowship. One critic castigated him for being "obsessed with reality." I wish the same could be said of our nation and our species.

Randi has done more than anyone else in recent times to expose pretension and fraud in the lucrative business of faith healing. He sifts refuse, reports gossip, listens in on the stream of "miraculous" information coming to the itinerant healer -- not by spiritual inspiration from God, but at the radio frequency 39.17 megahertz, transmitted by his wife backstage*; he discovers that those who rise from their wheelchairs and are declared healed had never before been confined to wheelchairs --

the religious

*Whose minions had interviewed the gullible parishioners only an hour or two earlier. How, except through God, could the preacher know their symptoms and street addresses? This scam of by faith-healer Peter Popoff, and exposed by Randi, was thinly fictionalized in the 1993 film Leap of Faith with actor Steve Martin.

they were invited by an usher to sit in them; he challenges the faith healers to provide serious medical evidence for the validity of their claims; he invites local and federal government agencies to enforce the laws against fraud and medical malpractice; he chastises the news media for their studied avoidance of the issue; he exposes the profound contempt of these faith healers for their patients and parishioners. Many are conscious charlatans -- using Christian evangelical or New Age language and symbols to prey on human frailty. Perhaps there are some with less than venal motives.

When conventional medicine fails, when we must confront pain and death, of course we are open to other prospects for hope. And, after all, some illnesses are psychogenic. Many can be at least ameliorated by a positive cast of mind. Placebos are dummy drugs, often sugar pills. Drug companies routinely compare the effectiveness of their drugs against placebos given to patients with the same disease who had no way to tell the difference between the drug and the placebo. Placebos can be astonishingly effective, especially for colds, anxiety, pain, and symptoms that are plausibly generated by the mind. Conceivably, endorphins -- ^{the} small brain proteins with morphine-like effects -- can be elicited by belief. ^{A placebo} ~~They~~ ^{thought} work only if the patient believes ~~the~~ ^{it's} ~~placebo~~ is an effective medicine. Within strict limits, hope, it seems, can be transformed into biochemistry.

who are not
cured by faith

~~The~~ ~~Those~~ apparent successes encourage ~~others~~. Unanswered prayers tend to be forgotten or dismissed. There is a real toll, though: The ~~unsuccessful~~ patients reproach themselves -- perhaps it's their own fault, perhaps they didn't believe hard enough. Skepticism, they are rightly told, is an impediment both to faith and to (placebo) healing.

But in almost every case what is treated is the symptom, not the disease. Like taking aspirins to mask stomach pain, the treatment may even exacerbate the illness. The patient may ^{also} abandon whatever benefit is provided by conventional medical practice, and be led to a reliance on magic.

Nearly half of all Americans believe there is such a thing as psychic or spiritual healing. Miraculous cures have been associated with a wide variety of healers, real and imagined, throughout human history. Scrofula, a kind of tuberculosis, was in England called the "King's evil," and was supposedly curable only by the King's touch. Victims patiently lined up to be touched; the monarch briefly submitted to another burdensome obligation of high office, and -- despite no one actually being cured -- the practice continued for centuries.

A famous Irish faith healer of the seventeenth century was Valentine Greatraks. He found, somewhat to his surprise, that he had the power to cure disease, including colds, ulcers, "soreness," and epilepsy. The demand for his services became so great that he had no time for anything else. He was forced to

reported
A In 1858, ~~the~~ an apparition of the Virgin Mary was ~~pro-~~
~~claimed~~ in Lourdes, France; the Mother of God confirmed the dogma
of her immaculate conception which had been proclaimed by Pope Pius IX
["Obsessed with Reality" (M, 11/28/94)] *just four years earlier.* 14

become a healer, he complained. His method was to cast out the demons responsible for disease. All diseases, he asserted, were caused by evil spirits -- many of whom he recognized and called by name. A contemporary chronicler noted that

he boasted of being much better acquainted with the intrigues of demons than he was with the affairs of men. . . . So great was the confidence in him, that the blind fancied they saw the light which they did not see -- the deaf imagined that they heard -- the lame that they walked straight, and the paralytic that they had recovered the use of their limbs. An idea of health made the sick forget for awhile their maladies; and imagination, which was not less active in those merely drawn by curiosity than in the sick, gave a false view to the one class, from the desire of seeing, as it operated a false cure on the other from the strong desire of being healed.

Something like a hundred million people have come to Lourdes, *since then* France in the hope of being cured, many with diseases *that* modern medicine is, so far, helpless to defeat. The Roman Catholic Church has authenticated only 64 miraculous cures in nearly a century and a half. The odds of such a cure then are about one in a million; you are roughly as likely to be cured at Lourdes as you are to win the lottery, or to die in the crash of a randomly-selected regularly-scheduled airplane flight *-- including the one taking you to Lourdes.* But even at Lourdes, the medical documentation of the alleged miracles is *very* ~~characteristically~~ weak.

The spontaneous remission rate of all cancers, lumped together, is estimated to be something between one in ten thousand and one in a hundred thousand. If no more than one percent of those who come to Lourdes *were* ~~are~~ there to treat their cancers, there should have been something between 10 and 100

"miraculous" cures of cancer alone. Since most of the attested 64 cures are not of cancer, the rate of spontaneous remission at Lourdes seems somewhat less than if the victims had stayed at home. Of course, if you're one of the 64, it's going to be very hard to convince you that your trip to Lourdes wasn't the cause of the remission of your disease. . . Post hoc, ergo propter hoc. These are very rough estimates; perhaps errors in diagnosis and diseases that at any rate would have been cured by the human immune system account for nearly all of the 64 cases. Something similar seems true of individual faith healers.

After hearing much from his patients about alleged faith healing, a Minnesota physician named William Nolen spent a year and a half trying to track down the most striking cases. Was there clear medical evidence that the disease was really present before the "cure"? If so, had the disease actually disappeared after the cure, or did we just have the healer's or the patient's say-so? He found not one case of significant cure of any serious organic (non-psychogenic) disease. There were no cases of healing gallstones or rheumatoid arthritis, say, much less cancer or cardiovascular disease. When a child's spleen is ruptured, Nolen noted, perform a simple surgical operation and the child is completely better. But take that child to a faith healer and she's dead in a day. Dr. Nolen's conclusion:

When [faith] healers treat serious organic disease, they are responsible for untold anguish and unhappiness. . . The healers become killers.

In the late medieval cures associated with apparitions of the Virgin Mary, ~~most~~^{most} were of sudden, whole-body or partial paralyzes that are plausibly psychogenic. (short-lived)

["Obsessed with Reality" (M, 11/28/94)]

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Even a recent book advocating the efficacy of prayer in treating disease [Larry Dossey, Healing Words] is troubled by the fact that some diseases are more easily cured or mitigated than others (if prayer works, why can't God cure cancer or grow back a severed limb?), and begins with a quote from Stanley Krippner, M.D. (described by Dossey as "one of the most authoritative investigators of the variety of unorthodox healing methods used around the world"):

[T]he research data on distant, prayer-based healing are promising, but too sparse to allow any firm conclusion to be drawn.

This after many trillions of prayers over the millennia.

The mind can cause certain diseases. When blindfolded patients are deceived into believing they're being touched by a leaf such as poison ivy or poison oak, they produce an ugly red contact dermatitis. What faith healing characteristically may help are similar mind-mediated or placebo diseases: some back and knee pains, headaches, stuttering, ulcers, stress, hay fever, asthma, hysterical paralysis and blindness, and false pregnancy (with cessation of menstrual periods and abdominal swelling).

These are all diseases in which the state of mind may play a key role. It's no surprise that appeals to a state of mind called faith can relieve symptoms caused, at least in part, by another, perhaps not very different, state of mind.

Occasionally, some of the pain and anxiety, or other symptoms, of more serious diseases can be relieved -- however,

In his ^{nearby} forgotten 1903 book, Christian Science, Mark Twain wrote: "The power which a man's imagination has over his body to heal it or make it sick is a force which none of us is born without. The first man had it, the last one will possess it."

~~It~~ In assessing the religion called Christian Science, Mark Twain -- its severest critic of the time -- nevertheless allowed that the bodies and lives it has "made whole" ~~more than~~ by the power of suggestion more than compensated for those it had killed by withholding medical treatment in favor of prayer.

["Obsessed with Reality" (M, 11/28/94)]

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without arresting the progress of the disease. But this is no small benefit. Faith and prayer may be able to relieve some symptoms of diseases and their treatment, ease the suffering of the afflicted, and even prolong lives a little. ↓

After his death, assorted Americans reported contact with the ghost of President John F. Kennedy. Before home shrines bearing his picture, miraculous cures began to be reported. "He gave his life for his people," one adherent of this stillborn religion explained. According to the Encyclopedia of American Religions, "To believers, Kennedy is thought of as a god." If such a belief system could arise spontaneously, think how much more could be done by a well-organized, and especially an unscrupulous, campaign.

It was widely held, moreover, that only devout believers could be^{so} cured.

* * *

In response to their inquiry, Randi suggested to Australia's Sixty Minutes that they generate a hoax from scratch -- using someone with no training in magic or public speaking, and no experience on the pulpit. As he was thinking the scam through, his eye fell upon Jose Alvarez, a young artist who was Randi's tenant. Why not? answered Alvarez, who when I met him seemed bright, good-humored, and thoughtful. He went through intensive training, including mock TV appearances and press conferences. He didn't have to think up the answers, though, but merely

pronounce them -- because he had a nearly invisible radio receiver in his ear, through which Randi was prompting. Emissaries from Sixty Minutes checked Alvarez's performance and traced weak points that might give the bamboozle away.

When Alvarez and his "manager" -- likewise recruited for the job with no previous experience -- arrived in Sydney, there was James Randi, slouching and inconspicuous, whispering into his transmitter, at the periphery of the action. The substantiating documentation had all been faked. The curse, the water-throwing, and all the rest were rehearsed to attract media attention. They did. Many of the people who showed up at the Opera House had done so because of the television and press attention. One Australian newspaper chain even printed verbatim handouts from the "Carlos Foundation."

After Sixty Minutes aired, the rest of the Australian media was furious. They had been used, they complained, lied to. "Just as there are legal guidelines concerning the police use of provocateurs," thundered Peter Robinson in the Australian Financial Review,

there must be limits to how far the media can go in setting up a misleading situation. . . I, for one, can simply not accept that telling a lie is an acceptable way of reporting the truth. . . Every poll of public opinion shows that there is a suspicion among the general public that the media do not tell the whole truth, or that they distort things, or that they exaggerate, or that they are biased.

Mr. Robinson feared that Carlos might have lent credence to this widespread misperception. Headlines ranged from "How Carlos Made

Fools of Them All" to "Hoax Was Just Dumb." Newspapers that had not trumpeted Carlos patted themselves on the back for their restraint. Negus said of Sixty Minutes, "Even people of integrity can make mistakes," and denied being duped. Anyone calling himself a channeller, he said, is "a fraud by definition."

Afterwards, Sixty Minutes and Randi stressed that the Australian media had made no serious effort to check any of "Carlos'" bona fides. He had never appeared in any of the cities listed. The videotape of Carlos on the stage of a New York theater had been a favor granted by the magicians Penn and Teller, who were appearing there. They asked the audience just to give a big hand of applause; Alvarez, in smock and necklace, walked on; the audience dutifully applauded, Randi got his videotape, Alvarez waved goodbye, ~~and~~ the show went on. And there is no New York City radio station with call letters WOOP.

Other reasons for suspicion could readily be mined in Carlos' writings. But because the intellectual currency has been so debased, because credulity -- New Age and Old -- is so rampant, because skeptical thinking is so rarely taught, no parody is too implausible. The Carlos Foundation offered for sale (they were scrupulously careful not actually to sell anything) an "ATLANTIS CRYSTAL":

Five of these unique crystals have so far been found by the ascended master during his travels. Unexplained by science, each crystal harnesses almost pure energy. . . [and has] enormous healing powers. The forms are actually fossilized spiritual energy and are a great boon to the preparation of

the Earth for the New Age. . . Of the Five, the ascended master wears one Atlantis crystal at all times close to his body for protection and to enhance all spiritual activities. Two have been acquired by kindly supplicants in the United States of America in exchange for the substantial contribution the ascended master requests.

Or, under the heading "THE WATERS OF CARLOS":

The ascended master finds occasionally water of such purity that he undertakes to energize a quantity of it for others to benefit, an intensive process. To produce what is always too little, the ascended master purifies himself and a quantity of pure quartz crystal fashioned into flasks. He then places himself and the crystals into a large copper bowl, polished and kept warm. For a twenty-four hour period the ascended master pours energy into the spiritual repository of the water. . . . The water need not be removed from the flask to be utilized spiritually. Simply holding the flask and concentrating on healing a wound or illness will produce astounding results. However, if serious mischance befalls you or a close one, a tiny dab of the energized water will immediately assist recovery.

Or, "TEARS OF CARLOS":

The red colour imparted to the holding flasks that the ascended master has fashioned for the tears is proof enough of their power, but their affect [sic] during meditation has been described by those who have experienced it as "a glorious Oneness."

Then there is a little book, The Teachings of Carlos, which begins:

I AM CARLOS.

I HAVE COME TO YOU

FROM MANY PAST

INCARNATIONS.

I HAVE A GREAT LESSON TO

TEACH YOU.

LISTEN CAREFULLY.

READ CAREFULLY.

THINK CAREFULLY.

THE TRUTH IS HERE.

The first teaching asks, "Why are we here. . .?" The answer: **"Who can say what is the one answer?"** [Italicized:] There are many answers to any question, and all the answers are right answers. It is so. Do you see?" [End italics.]

The book enjoins us not to turn to the next page until we have understood the page we are on. This is one of several factors that makes finishing it difficult.

"Of doubters," it reveals later, "I can say only this: let them take from the matter just what they wish. They end up with nothing -- a handful of space, perhaps. And what does the believer have? EVERYTHING! All questions are answered, since all and any answers are correct answers. And the answers are right! Argue that, doubter."

Or: "Don't ask for explanations of everything. Westerners, in particular, are always demanding long-winded descriptions of why this, and why that. Most of what is asked is obvious. Why bother with probing into these matters?. . . By belief, all

things become true."

The last page of the book displays a single word in large letters: Belatedly, we are exhorted to "THINK!"

The full text of The Teachings of Carlos was of course written by Randi. He dashed it off on his laptop computer in a few hours.

The Australian media felt betrayed by one of their own. The leading television program in the country had gone out of its way to expose shoddy standards of fact-checking and rampant gullibility in institutions devoted to news and public affairs. Some media analysts excused it on the grounds that it obviously wasn't important; if it had been important, they would have checked it out. There were few mea culpas. None who had been taken in were willing to appear on a retrospective of the "Carlos Affair" scheduled for the following Sunday on Sixty Minutes.

Of course, there's nothing special about Australia in all of this. Alvarez, Randi, and their co-conspirators could have chosen any nation on Earth and it would have worked. Even those who gave Carlos a national television audience knew enough to ask some skeptical questions -- but they couldn't resist inviting him to appear in the first place. The internecine struggle within the media dominated the headlines after Carlos' departure. Puzzled commentaries were written about the exposé. What was the point? What was proved?

Alvarez and Randi proved how little it takes to tamper with our beliefs, how readily we are led, how easy it is to fool the public when people are lonely and starved for something to believe in. If Carlos had stayed longer in Australia and concentrated more on healing -- by prayer, by believing in him, or wishing at his bottled tears, or stroking his crystals -- there's no doubt that people would have reported being cured of many illnesses, especially psychogenic ones. Even with nothing more fraudulent than his appearance, sayings, and ancillary products, some people would have gotten better because of Carlos.

This, again, is the placebo effect found with almost every faith healer. We believe we're taking a potent medicine and the pain goes away -- for a time at least. And when we believe we've received a potent spiritual cure, the disease sometimes also goes away -- for a time at least. Some people spontaneously announce that they've been cured even when they haven't. Detailed follow-ups by Nolen, Randi, and many others of those who have been told they were cured, and agreed that they were -- in, say, televised services by American faith healers -- show that not one with serious organic disease was in fact cured. Even significant improvement in their condition is dubious.

A faith healer may or may not start out with fraud in mind. But to his amazement, his patients actually seem to be improving. Their emotions are genuine, their gratitude heart-felt. When the healer is criticized, such people rush to his defense. Several

elderly attendees of the channelling at the Sydney Opera House were incensed after the Sixty Minutes exposé: "Never mind what they say," they told Alvarez, "we believe in you."

These successes may be enough to convince many charlatans -- no matter how cynical they were at the beginning -- that they actually have mystical powers. Maybe they're not successful every time. The powers come and go, they tell themselves. They have to cover the down time. If they must cheat a little now and then, it serves a higher purpose, they tell themselves. Their spiel is consumer-tested. It works.

Most of these figures are only after your money. That's the good news. But what worries me is that a Carlos will come along with bigger fish to fry -- attractive, commanding, patriotic, exuding leadership. All of us long for a competent, uncorrupt, charismatic leader. We will leap at the opportunity to support, to believe, to feel good. Most reporters, editors, and producers -- swept up with the rest of us -- will shy away from real skeptical scrutiny. He won't be selling you prayers or crystals or tears. Perhaps he'll be selling you a war, or a scapegoat, or a much more all-encompassing bundle of beliefs than Carlos'. Whatever it is, it will be accompanied by warnings about the dangers of skepticism.

In the celebrated film The Wizard of Oz, Dorothy, the Scarecrow, the Tin Woodsman, and the Cowardly Lion are intimidated -- indeed awed -- by the out-sized oracular figure

called the Great Oz. But Dorothy's little dog Toto snaps at a concealing curtain and reveals that the Great Oz is in fact a machine run by a small, tubby, frightened man, as much an exile in this strange land as they.

I think we're lucky that James Randi is tugging at the curtain. But it would be as dangerous to rely on him to expose all the quacks, humbugs, and bunkum in the world as it would to believe those same charlatans. If we don't want to get taken, we need to do this job for ourselves.

* * *

One of the saddest lessons of history is this: If we've been bamboozled long enough, we tend to reject any evidence of the bamboozle. ~~Then~~ [✓] we're no longer interested in finding out the truth. The bamboozle has captured us. It's simply too painful to acknowledge, ~~even~~ [✓] even to ourselves, ~~that~~ [✓] that we've been taken. Once you give ~~such~~ a charlatan power over you, you almost never get it back. So the old bamboozles tend to persist as the new ones rise.

Thus, seances occur only in darkened rooms, where the ghostly visitors can be seen dimly at best. If we turn up the lights a little, so we have a chance to see what's going on, the spirits vanish. They're shy, we're told, and some of us believe it. In twentieth-century parapsychology laboratories, there is

the "observer effect": Those described as gifted psychics find their powers diminish markedly as soon as skeptics present themselves, and disappear altogether in the presence of a conjurer as skilled as James Randi. What they need is darkness and gullibility.

A little girl who had been a co-conspirator in a famous nineteenth-century flimflam -- spirit-rapping, in which ghosts answer questions by loud thumping -- grew up and confessed it was an imposture. She was cracking the joint in her big toe. *She demonstrated how it was done* But the public apology was largely ignored and, when acknowledged, denounced. Spirit-rapping was too reassuring to be abandoned merely on the say-so of a self-confessed rapper, even if she started the whole business in the first place. The story began to circulate that the confession was coerced out of her by fanatical rationalists.

As I described earlier, British hoaxers confessed to having made "crop circles," geometrical figures generated in grain fields. It wasn't alien artists working in wheat as their medium, but two blokes with a board, a rope, and a taste for whimsy. Even when they demonstrated how they did it, though, believers were unimpressed. Maybe some of the crop circles are hoaxes, they argued, but there are too many of them, and some of the pictograms are too complex. Only extraterrestrials could do it. Then others in Britain confessed. But crop circles abroad, it was objected, in Hungary for example, how can you explain

that? Then copycat Hungarian teen-agers confessed. But what about. . .?

To test the credulity of an alien abduction psychiatrist, a woman poses as an abductee. The therapist is enthusiastic about the fantasies she spins. But when she announces it was all a fake, what is his response? To re-examine his protocols or his understanding of what these cases mean? No. On various days he suggests (1) even if she isn't herself aware of it, she was in fact abducted; or (2) she's crazy -- after all, she went to a psychiatrist, didn't she?; or (3) he was on top of the hoax from the beginning and just gave her enough rope to hang herself.

If it's sometimes easier to reject strong evidence than to admit that we've been wrong, this is information about ourselves worth having.

* * *

A scientist places an ad in a Paris newspaper offering a free horoscope. He receives about 150 replies, each, as requested, detailing a place and time of birth. Every respondent is then sent the identical horoscope, along with a questionnaire asking how accurate the horoscope had been. Ninety-four percent of the respondents (and ninety percent of their families and friends) reply that they were at least recognizable in the horoscope. However, the horoscope was drawn up for a French mass

murderer. If an astrologer can get this far without even meeting his subjects, think how well someone sensitive to human nuances and not overly scrupulous might do.

Why are we so easily taken in by fortune-tellers, psychic seers, palmists, tea-leaf, tarot, and yarrow stick readers, and their ilk? Of course, they note our posture, facial expressions, clothing, and answers to seemingly innocuous questions. Some of them are brilliant at it, and these are areas about which many scientists seem almost unconscious. There is a computer network to which psychics subscribe, the details of their customers' lives available to their colleagues in an instant. But a key tool is the so-called "cold read," a statement of opposing predispositions so tenuously balanced that anyone will recognize a grain of truth. Here's an example:

At times you are extroverted, affable, sociable, while at other times you are introverted, wary, and reserved. You have found it unwise to be too frank in revealing yourself to others. You prefer a certain amount of change and variety, and become dissatisfied when hemmed in by restrictions and limitations. Disciplined and controlled on the outside, you tend to be worrisome and insecure on the inside. While you have some personality weaknesses, you are generally able to compensate for them. You have a great deal of unused capacity, which you have not turned to your advantage. You have a tendency to be critical of yourself. You have a strong need for other people to like you and for them to admire you.

Almost everyone finds this characterization recognizable, and many feel that it describes them perfectly. Small wonder: We are all human.

The list of "evidence" which some therapists think demonstrates repressed childhood sexual abuse (for example, in The Courage to Heal, by Ellen Bass and Laura Davis) is very long and prosaic: It includes sleep disorders, overeating, anorexia and bulimia, sexual dysfunction, vague anxieties, and even an inability to remember childhood sexual abuse. Another book, by the social worker E. Sue Blume, lists, among other telltale signs of forgotten incest: headaches, suspicion or its absence, excessive sexual passion or its absence, and adoring one's parents. Among diagnostic items for detecting "dysfunctional" families listed by Charles Whitfield, M.D., are "aches and pains," feeling "more alive" in a crisis, being anxious about "authority figures," and having "tried counseling ~~or~~ or ~~24~~, psychotherapy," yet feeling "that 'something' is wrong or missing." Like the cold read, if the list is long enough, everyone will have "symptoms."

Skeptical scrutiny of pseudoscience is not only a matter of rooting out bunkum and cruelty that prey on those least able to defend themselves and most in need of our compassion, people offered little other hope. It is also a timely reminder that mass rallies and television, electronic marketing, and mail-order technology permit other kinds of lies to be injected into the body politic, to take advantage of the frustrated, the unwary, and the defenseless in a society riddled with political ills that are being treated ineffectively if at all.

Baloney, bamboozles, careless thinking, flimflam, and wishes disguised as facts are not restricted to parlor magic and ambiguous advice on matters of the heart. Unfortunately, they ripple through mainstream ^{medical,} political, social, religious, and economic issues in every nation.

Chapter 13

~~PSEUDOSCIENCE~~ AND ANTISCIENCE

There's no such thing as objective truth. We make our own truth. There's no such thing as objective reality. We make our own reality. There are spiritual, mystical, or inner ways of knowing that are superior to our ordinary ways of knowing. If an experience seems real, it is real. If an idea feels right to you, it is right. We are incapable of acquiring knowledge of the true nature of reality. Science itself is irrational or mystical. It's just another faith or belief system or myth, with no more justification than any other. It doesn't matter whether beliefs are true or not, as long as they're meaningful to you.

-- a summary of New Age beliefs, from Theodore Schick, Jr. and Lewis Vaughn, How to Think About Weird Things: Critical Thinking for a New Age (Mountain View, CA: Mayfield Publishing Company, 1995)

If the established framework of science is plausibly in error (or arbitrary, or irrelevant, or unpatriotic, or impious, or mainly serving the interests of the powerful), then perhaps we can save ourselves the trouble of understanding it -- what so many people think of as a complex, difficult, highly mathematical, and counterintuitive body of knowledge. Then all the scientists who, it sometimes seems, have secretly lorded it over us with their superior understanding of the world would have their comeuppance. Science envy could be transcended. Those who have pursued other paths to knowledge, those who have secretly harbored beliefs that science has scorned, could now have their ^{place} ~~day~~ in the Sun.

His view on Constitutional guarantees can be gleaned from the following response to a witness' lawyer: "The rights you have are the rights given you by this Committee. We will determine what rights you have and what rights you have not got before the Committee."

["Pseudoscience and Antiscience" (M, 11/28/94)]

2

The rate of change in science is responsible for some of the fire it draws. Just when we've finally understood something the scientists are talking about, they tell us it isn't any longer true. And even if it is, there's a slew of new things -- things we never heard of, things difficult to believe, things with disquieting implications -- that they claim to have discovered recently. Scientists can be perceived as toying with us, as wanting to overturn everything, as socially dangerous.

Edward U. Condon was a distinguished American physicist, a participant in the development of radar and nuclear weapons in World War II, pioneer in quantum mechanics, research director of Corning Glass, director of the National Bureau of Standards, and president of the American Physical Society (as well as, late in his life, professor of physics at the University of Colorado, where he directed a controversial Air Force-funded scientific study of UFOs). He was one of the physicists whose loyalty to the United States was challenged by members of Congress -- including who called for the revocation of his security clearance Congressman Richard M. Nixon -- in the late 1940s and early 1950s. (Condon called the House ^{Committee on} Unamerican Activities Committee that was behind much of this inquisition "the Unamericans." ^{The} ~~its~~ superpatriotic chairman, Rep. J. Parnell Thomas {check}, called the physicist "Dr. Condom," Thomas was shortly afterwards thrown in jail for fraud {check}. ~~Condon called the Committee that was behind much of this inquisition, "the Unamericans."~~

I remember vividly ^{his} Condon's account of being brought up before some Congressionally-mandated loyalty review board:

the "weakest link" in American security, and -- at one point -- the "missing link."

padding his Congressional payroll

One summer in graduate school I was a student of Condon's.

"Dr. Condon, it says here that you have been at the forefront of a revolutionary movement in physics called" -- and here the inquisitor read the words slowly and carefully -- "quantum mechanics. It strikes this hearing that if you could be at the forefront of one revolutionary movement. . . you could be at the forefront of another."

Condon, quick on his feet, replied that the accusation was untrue. He was not a revolutionary in physics. He raised his right hand: "I believe in Archimedes' Principle, formulated in the third century B.C. I believe in Kepler's laws of planetary motion, discovered in the seventeenth century. I believe in Newton's laws of motion. . ." And on he went, invoking the illustrious names of Bernoulli, Fourier, Ampère, Boltzmann, and Maxwell. This physicist's catechism did not gain him much. The tribunal did not appreciate humor on so serious a matter. But the most they were able to pin on Condon, as I recall, was that in high school he had a job delivering a socialist newspaper door-to-door on his bicycle.

In 1948 President Harry Truman denounced Rep. Thomas and HUAC on the grounds that vital scientific research "may be made impossible by the creation of an atmosphere in which no man feels safe against the public airing of unfounded rumors, gossip and vilification." He called HUAC's activities "the most un-American thing we have to contend with today. It is the climate of a totalitarian country."

Imagine you seriously want to understand what quantum mechanics is about. There is a mathematical underpinning that you must first acquire, mastery of each mathematical subdiscipline leading you to the threshold of the next. In turn

The playwright Arthur Miller wrote "The Crucible," about the Salem Witch Trials in this period. When, called before HCUA, he was chastised for his injustices, he replied the suggestion that Congressional investigations might have something in common with witch trials he replied, "The comparison is inevitable, Sir."

-- at the Annual Meeting of the American Association for the Advancement of Science, and with Condon sitting beside him --

you must learn arithmetic, Euclidian geometry, high school algebra, differential and integral calculus, ordinary and partial differential equations, vector calculus, certain special functions of mathematical physics, matrix algebra, and group theory. For most physics students, this might occupy them from, say, third grade to first year of graduate school -- roughly 15 years. Such a course of study does not actually involve learning any quantum mechanics, but merely establishes the mathematical framework required to approach it deeply.

The job of the popularizer of science, trying to get across some idea of quantum mechanics to a general audience that has not gone through these initiation rites, is daunting. Indeed, there are no successful popularizations of quantum mechanics in my opinion -- partly for this reason. These difficulties are compounded by the fact that quantum mechanics is so resolutely counterintuitive. Common sense is almost useless in approaching it. It's no good, as Richard Feynman once said, asking why it is that way. No one knows why it is that way. That's just the way it is.

Now suppose we were to approach some obscure religion or New Age doctrine or shamanistic belief system skeptically. We have an open mind; we understand there's something interesting here; we introduce ourselves to the practitioner and ask for an intelligible summary. Instead we are told that it's intrinsically too difficult to be explained simply, but if we're

willing to become acolytes for 15 years, at the end of that time we might begin to be prepared to consider the subject seriously. Most of us, I think, would say that we simply don't have the time; and many would suspect that the business about 15 years just to get to the threshold of understanding is evidence that the whole subject is a bamboozle: If it's too hard for us to understand, doesn't it follow that it's too hard for us to criticize knowledgeably? Then the bamboozle has free rein.

Now how is shamanistic or theological or New Age doctrine different from quantum mechanics? The answer is that even if we cannot understand it, we can verify that quantum mechanics works. We can compare the quantitative predictions of quantum theory with the wavelengths of spectral lines of the chemical elements, the behavior of semiconductors and liquid helium, which kinds of molecules form from their constituent atoms, the existence and properties of white dwarf stars, what happens in ^{masers and} ~~a~~ laser^s, and which materials are susceptible to which kinds of magnetism. We don't have to understand the theory to see what it predicts. We don't have to be ^{much of} a physicist to ^{experiments reveal} ~~see~~ what ~~is observed~~. In every one of these instances -- as in many others -- the predictions of quantum mechanics are strikingly, and to high accuracy, confirmed.

But the shaman tells us that his doctrine is true because it too works -- not on arcane matters of mathematical physics but on what really counts: He can cure people. Very well, then, let's

accumulate the statistics on shamanistic cures, and see if they work better than placebos. If they do, let's willingly grant that there's something here -- even if it's only that some illnesses are psychogenic, and can be cured or mitigated by the right attitudes and mental states. We can also compare the efficacy of the various shamanistic systems.

Whether the shaman grasps why his cures work is another story. In quantum mechanics we have a purported understanding of Nature on the basis of which, step by step and quantitatively, we make predictions about what will happen if a certain experiment, never before attempted, is carried out. If the experiment bears out the prediction -- especially if it does so numerically and precisely -- we have confidence that we knew what we were doing. There are few examples with this character among shamans, priests, and New Age gurus.

Another important distinction was suggested in Reason and Nature, the 1931 book by Morris Cohen, a celebrated philosopher of science:

To be sure, the vast majority of people who are untrained can accept the results of science only on authority. But there is obviously an important difference between an establishment that is open and invites every one to come, study its methods, and suggest improvement, and one that regards the questioning of its credentials as due to wickedness of heart, such as [Cardinal] Newman attributed to those who questioned the infallibility of the Bible. . . . Rational science treats its credit notes as always redeemable on demand, while non-rational authoritarianism regards the demand for the redemption of its paper as a disloyal lack of faith.

[12-11-94.at1]

using the rich
molecular treasures
in the plant kingdom to

over ~~many~~ generations -- ^{experiments} that moreover could not be ^{duplicated} ~~done~~ today

for reasons of medical ethics. Think of how many bark infusions
^{from other trees} ~~been useless, or~~ ^{retch or even die. In such a case,}
must have made the patient ~~throw up, or worse.~~ ^{Then the medicine}

^{healer} ~~men~~ chalk those potential medicines off the list, and move ^{on} to
^{(By patient and systematic records,}
the next trial and error, ^{and} eventually they get there, --

^{accumulating} establishing a pharmacopoeia that ~~really~~ works. ^{life-saving} There is
^{absolutely essential, information that we can acquire, in no other}

way. ^{for, say,} ~~from folk ethnomedicine.~~ Likewise predicting the weather in

a valley near the Orinoco: It is perfectly possible that

preindustrial people ^{the millennia} have noted over ~~thousands~~ of years

regularities, premonitory indications, cause-and-effect
relationships at a particular geographic locale ^{at which distant} that professors
of meteorology and climatology ^{in some distant university} are wholly ignorant ~~about~~. But it
does not follow that the shamans of such cultures are able to
predict the global climate.

Certain kinds of folk knowledge are valid and priceless.
Others are at best metaphors and codifiers. Ethnomedicine, yes;
astrophysics, no. It is certainly true that all beliefs and all
myths are worthy of a respectful hearing. It is not true that
all folk beliefs are equally valid ^{if we're talking not about an}
internal mindset, but about ^{understanding} the external reality.

Smart Z, Ch 13, p.7.

For The Demon-Haunted World:

The myths and folklore of many ^{modern} prescientific cultures have ^{or at least mnemonic} explanatory value. ^{In} ~~They~~ encode the environment into stories that everyone can appreciate and even witness, Which constellations are rising or the orientation of the Milky Way on a given day of the year can be remembered and recognized by a story about lovers reunited or a ~~sacred~~ ^{negotiating} canoe on the sacred river. And since recognizing the sky is essential for planting and reaping and following the game, such stories have important practical value. But that doesn't mean that the Milky Way really is a river or that a canoe ^{really} is traversing it before our eyes. Human beings of ten thousand years ago were almost certainly ~~just~~ as smart as we are today. But they didn't have ~~science~~; they didn't have a systematic method of challenging their own hypotheses. And as ^{They can also be helpful} ~~beneficial as such stories are as psychological projective tests~~ or, ^{as} reassurances of humanity's place in the Universe, ~~they do not necessarily correspond to the external reality.~~

Quinine comes from an infusion of the bark of a particular ^{from} tree in the Amazon rain forest. How did ^{modern} prescientific people ^{that} ~~ever discover to make a tea of this particular bark to relieve~~ the symptoms of malaria? ~~It seems very clear that they must have tried every tree in the forest, every plant, roots, stems, leaves, --~~ ^{and} ~~at~~ ^{chewing on} ~~them directly, mash them up, make a tea. And this~~ constitutes a set of ^{ing} ~~massive~~ scientific experiments continuing ^{making an infusion.}

Quaint Z

* * *

For centuries, science has been under a line of attack that, rather than pseudoscience, can be called antiscience. Science, and academic scholarship in general, the contention these days goes, is too subjective. Some even allege it's entirely subjective, as is, they say, history. History generally is written by the victors to justify their actions, to arouse patriotic fervor, and to suppress the legitimate claims of the vanquished. When no overwhelming victory takes place, each side writes self-promotional accounts of what really happened. English histories castigate the French, and vice versa; U.S. histories until very recently have sided almost entirely with the Colonists rather than the Native Americans whom they displaced (not hard to understand: the histories were written by the actual as well as the intellectual descendants of the Colonists); Japanese histories of the events leading to World War II minimize Japanese atrocities, and suggest that their chief purpose was altruistically to free East Asia from European and American colonialism; Poland was invaded in 1939, Nazi historians asserted, because Poland, ruthless and unprovoked, attacked Germany; Soviet historians pretended that the Soviet troops that put down the Hungarian (1956) and Czech (1968) Revolutions were invited in by general acclamation in those nations rather than by Russian stooges; Belgian histories tend to gloss over the

atrocities committed when the Congo was a private fiefdom of the King of Belgium; Chinese historians are strangely oblivious of the tens of millions of deaths caused by Mao Zedong's "Great Leap Forward"; that God condones and even advocates slavery is repeatedly argued from the pulpit and in the schools in Christian slave-holding societies, but Christian polities that have freed their slaves are silent on the subject; as brilliant, widely-

read, and sober a historian as Edward Gibbon would not ~~shake~~ ^{meet}

when they found themselves at an English country inn --

~~hands~~ with Benjamin Franklin ~~[cheek]~~ because of the late

unpleasantness of the American Revolution.

(Franklin then volunteered source material to Gibbon when he turned, as Franklin was sure he soon would, from the decline and fall of the Roman Empire to the decline and fall of the British Empire. Franklin was right, but his timetable, about

These histories have traditionally been written by admired ^{two} academic historians, often pillars of the establishment. Local ^{centuries} dissent ^{is} ~~was~~ given short shrift. Objectivity ^{is} ~~was~~ sacrificed in

the service of higher goals. From this doleful fact, some have gone so far as to conclude that there is no such thing as

history, no possibility of reconstructing the actual events; that all we have are biased self-justifications; and that this conclusion stretches from history to all of knowledge, science included.

And yet who would deny that there were actual sequences of historical events, with real causal threads, even if our ability to reconstruct them in their full weave is limited, even if the signal is awash in an ocean of self-congratulatory noise? It is the job of those historians with integrity to try to reconstruct that actual sequence of events, however alarming or disappointing

it may be. Historians learn to suppress their natural indignation about affronts to their nations and acknowledge, where appropriate, that their national leaders may have committed atrocious crimes. They recognize that accounts of events have passed through biased human filters, and that historians themselves have biases. ^{Those} ~~The~~ ~~historian~~ who wants to know what actually happened will become fully conversant with the views of historians in other, once adversary, nations. ~~Self-knowledge~~ ~~does not guarantee a perfect reconstruction of events.~~ All that can be hoped for is a set of successive approximations: By slow steps, and through ^{improving} self-knowledge, our understanding of historical events improves.

Something similar is true in science. We have biases; we breathe in the prevailing prejudices from our surroundings like everyone else. Scientists have on occasion given aid and comfort to a variety of noxious doctrines (including the supposed "superiority" of one ethnic group over another from measurements of brain size or skull bumps or IQ tests). Scientists are often reluctant to offend the rich and powerful. Scientists also exhibit biases connected with human chauvinisms and with our ~~Many are ambitious and competitive~~ ^{among others} intellectual limitations. ^{At} For all these reasons, we make mistakes. Accordingly, it is the job of the scientist to recognize our weaknesses, to examine the widest range of opinions, to be ruthlessly self-critical. Science is a collective enterprise with the error-correction machinery often

running smoothly. It has an overwhelming advantage over history, because in science we can do experiments. If you are unsure of the ^{negotiations} ~~events~~ leading to the Treaty of Paris in 1814-1815, replaying the events is an unavailable option. You can only dig into old records. You cannot even ask questions of the participants. Every one of them is dead.

But for many questions in science, you can rerun the event as many times as you like, examine it in new ways, give alternative views free rein. When new tools are devised, you can perform the experiment again and see what emerges from your improved sensitivity. In those historical sciences where you cannot arrange a rerun, you can examine related cases and begin to recognize their common components. We can't make stars explode at our convenience, nor can we repeatedly evolve through many trials a mammal from its ancestors. But we can simulate some of the physics of supernova explosions in the laboratory, and we can witness the evolution of hereditary molecules that copy themselves in the test tube. The key strength that science has and history doesn't is, once again, experiment.

* * *

Anyone who witnesses the advance of science first-hand sees an intensely personal undertaking. There are always a few -- driven by simple wonder, or by frustration with the inadequacies

of existing knowledge, or simply upset with themselves for their imagined inability to understand what everyone else can -- who proceed to ask the key and devastating question. A few saintly personalities stand out amidst a roiling sea of jealousies, ambition, backbiting, suppression of dissent, and absurd conceits. In some fields, highly productive fields, such behavior is almost the norm.

I think all that social turmoil and human weakness aids the enterprise of science. There is an established framework in which any scientist can prove another wrong and make sure everyone else knows about it. Even when our motives are base, we keep stumbling on something new.

The American chemistry Nobel laureate Harold C. Urey once told me that as he got older (he was then in his seventies), he experienced increasingly concerted efforts to prove him wrong. He described it as "the fastest gun in the West" syndrome: The young man who could outdraw the celebrated old gunslinger would inherit his reputation and the respect paid to him. It was annoying, he confided, but it did help direct the young whippersnappers into important areas of research.

Being human, scientists like to remember those cases when they've been right and forget when they've been wrong. But in many instances, what is "wrong" is partly right, or stimulates others to find out what's right. One of the most productive astrophysicists of our time has been Fred Hoyle, responsible for

monumental contributions to our understanding of the evolution of stars, the synthesis of the chemical elements, cosmology, and much else. Sometimes he's succeeded by being right before anyone else even understood that there was something that needed explaining. Sometimes he's succeeded by being wrong -- by being so provocative, by suggesting such outrageous alternatives that the observers ^{and} ~~or~~ experimentalists feel obliged to check it out. The impassioned effort to "prove Fred wrong" has sometimes failed and sometimes succeeded. In almost every case, it has pushed forward the frontiers of knowledge. Even Hoyle at his most outrageous -- proposing that the influenza and HIV viruses, for example, are dropped down on Earth from comets, and that interstellar dust grains are bacteria -- has led to significant advances in knowledge.

These days there are critics who confess themselves amazed that scientists or historians can be corrupted by their time and culture. Political leaders are so corrupted; religious leaders are so corrupted; why not scientists and historians? Whoever thought them immune?

Postmodernists have criticized Kepler's astronomy because it emerged out of his medieval, monotheistic religious views; Darwin's ^{evolutionary biology} [^] for being motivated by a wish to perpetuate the privileged social class from which he came, or to justify his ^{supposed} [^] prior atheism; and so on. Some of these claims are just. Some are not. But why does it matter what biases and emotional predispositions scientists

bring to their studies -- so long as they are scrupulously honest and other people with different proclivities check their results? Presumably no one would argue that the conservative view on the sum of 14 and 27 differs from the liberal view, or that the mathematical function that is its own derivative is the exponential in the northern hemisphere but some other function in the southern. Any regular periodic function can be represented to arbitrary accuracy by a Fourier series in Muslim as well as in Hindu mathematics. Non-commutative algebras (where $A \times B$ does not equal $B \times A$) are as self-consistent and meaningful for speakers of Indo-European languages as for speakers of ~~Chinese~~ ^{Finno-Ugric}. Mathematics might be prized or ignored, but it is equally true everywhere -- independent of ethnicity, culture, language, religion, ideology.

Towards the opposite extreme, there are questions such as whether abstract expressionism can be "great" art, or rap "great" music; whether it's more important to curb inflation or ~~to worry about~~ unemployment; whether French culture is superior to German culture; or whether prohibitions against murder should apply to the nation state. Here the questions are oversimple, or the dichotomies false, or the answers dependent on unspoken assumptions. Here local cultural norms and biases might very well determine the answers.

Where in this subjective continuum, from almost fully independent of cultural norms to almost wholly dependent on them,

does science lie? I would like to argue that although issues of bias and cultural chauvinism certainly arise, and although its tenets are constantly being refined, science is much closer to mathematics than it is to fashion; and the claim that its findings are generally arbitrary and biased is not merely tendentious, but specious.

The historians Joyce Appleby, Lynn Hunt, and Margaret Jacob (in Telling the Truth About History, 1994) criticize Isaac Newton: He is said to have rejected the philosophical position of Descartes because it might challenge conventional religion and lead to social chaos and atheism. Such criticisms amount only to the charge that scientists are human. How Newton was buffeted by the intellectual currents of his time is of course of interest to the historian of ideas; but it has little bearing on the truth of his propositions. For them to be ^{generally}~~widely~~ accepted, they must convince atheists and theists alike. This is just what happened.

On the other hand, Appleby et al. claim that "When Darwin formulated his theory of evolution, he was an atheist and a materialist," and suggest that evolution was a product of his purported atheist agenda. They have hopelessly confused cause and effect. Darwin was about to become a minister of the Church of England when the opportunity to sail on H.M.S. Beagle presented itself. His religious ideas, as he himself described them, were at the time highly conventional. He adhered to every one of the Anglican Articles of Faith. Through his interrogation

of Nature, it slowly dawned on him that at least some of his religion was false. That's why he changed his religious views.

Appleby ^{and her colleagues} ~~et al.~~ ^{at} are appalled ^{description of} ~~that Darwin described what he~~ ~~understood as~~ "the low morality of savages. . . their insufficient powers of reasoning. . . [their] weak power of self-command," and state that "Now many people are shocked by his racism." But there was no racism at all, as far as I can tell, in Darwin's comment. He was ^{alluding to} ~~describing~~ the environmentally stressed inhabitants of Tierra del Fuego, in the most barren and Antarctic province of Argentina. When he described a South American woman of African origin who threw herself to her death rather than submit to slavery, he noted that it was only prejudice that kept us from seeing her defiance in the same ^{heroic} light as we would a similar act by the proud matron of a noble Roman family. He was ^{himself} ~~almost~~ thrown off the Beagle by Captain FitzRoy for his opposition to the Captain's racism. Darwin was head and shoulders above most of his contemporaries in this regard.

But again, even if he was not, how does it affect the truth or falsity of natural selection? Thomas Jefferson and George Washington owned slaves; Albert Einstein and Mohandas Gandhi were imperfect husbands and fathers. The list goes on indefinitely. We are all flawed and creatures of our ~~own~~ times; is it fair to judge us by the standards of the future? The ~~personal~~ habits of our time will doubtless be criticized by later generations -- perhaps for insisting that small children and even infants sleep

alone instead of with their parents; or exciting nationalist passions as a means of gaining popular approval or achieving high political office; or continuing bribery and corruption as a way of life; or keeping pets; or eating animals and jailing chimpanzees; or criminalizing the use of euphorants; or allowing our children to grow up ignorant.

Occasionally, in retrospect, someone stands out. In my book, the American revolutionary Thomas Paine is one such. He opposed monarchy, racism, slavery, and sexism when all of these were the conventional wisdom. But he was so far ahead of his time, and as a result suffered so much (including being thrown into the Bastille ^{after the French Revolution} for being too consistent in his opposition to tyranny), that he ~~grew to become~~ ^a an embittered old man. Let us not hold others to standards we are not willing to be held to ourselves.

Yes, the Darwinian insight can be turned upside down and grotesquely misused: Voracious robber barons may justify their cutthroat practices by an appeal to Social Darwinism; Nazis and other racists may appeal to "survival of the fittest" to explain genocide. But Darwin did not make John D. Rockefeller or Adolf Hitler. Greed, the Industrial Revolution, the free enterprise system, and corruption of government by the monied are adequate to explain nineteenth-century capitalism. Ethnocentrism, xenophobia, social hierarchies, the long history of anti-Semitism in Germany, Versailles, German child-rearing practices, inflation

and the Depression seem adequate to explain Hitler's rise to power. Very likely these or similar events would have transpired with or without Darwin. And modern Darwinism makes it abundantly clear that many less ruthless traits, traits not always admired by robber barons and Führers -- altruism, general intelligence, tool use, compassion -- may be the key to survival.

If we could censor Darwin, what other kinds of knowledge could also now be censored? Who would do the censoring? Who among us is wise enough to know which information and insights we can safely dispense with, and which will be necessary ten or a hundred or a thousand years into the future? Surely we can exert some discretion in technology, on which kinds of machines and products it is safe to develop. We must in any case make such decisions, because we do not have the resources to pursue all possible technologies. But censoring knowledge, telling people what they must think and what ideas are impermissible, which lines of evidence may not be pursued, is the aperture to thought police, authoritarian government, foolish and incompetent decision-making, and long-term decline.

* * *

It might be useful for scientists now and again to list some of their mistakes. It might play an instructive role in illuminating and demythologizing the process of science and in

enlightening younger scientists. Even Isaac Newton, Charles ^{Gregor Mendel,} Darwin, [^] and Albert Einstein made mistakes. But the scientific enterprise arranges things so that teamwork prevails: What one of us, even the most brilliant among us, misses, another of us, even someone much less celebrated and capable, can detect and rectify.

For myself, I've tended in past books to recount some of the occasions when I've been right. Let me here mention a few of the cases where I've been wrong: At a time when no spacecraft had been to Venus, I thought at first that the atmospheric pressure was several times that on Earth, rather than many tens of times. I thought the clouds of Venus were made mainly of water, when they turn out to be only 25 percent water. I thought there might be plate tectonics on Mars, when close-up spacecraft observations now show hardly a hint of plate tectonics. I thought the highish infrared temperatures of Titan might be due to a sizable greenhouse effect there; instead, it turns out, it is caused by a stratospheric temperature inversion. Just before Iraq torched the Kuwaiti oil wells in 1991, I warned that so much smoke might

get so high as to disrupt agriculture in much of South Asia; ^{as events trans-} ~~pired, it was pitch black at noon and the temperatures dropped 4-6° F over the Persian Gulf, but while the physical principles behind the calculation still seem~~ ^{the not much smoke reached stratospheric altitudes and Asia was} ~~right, and a little more smoke might indeed have had calamitous~~

^{spared;} ~~consequences,~~ I did not sufficiently stress the uncertainty of the calculations.

Smart I, Ch 13, p. 19

Perhaps the most controversial scientific debate I've been involved ^{with} ~~in~~ concerns nuclear winter -- the predicted cooling and darkening of the Earth ~~followed~~ ^{by sooty smoke} following a global thermonuclear war. But ~~this contro-~~
~~versy~~ ^{debate} was politically driven; the strategic implications of nuclear winter were disquieting to those wedded to a policy of massive retaliation for a nuclear attack. The global temperature declines predicted ~~in~~ in the original (1983) nuclear winter scientific paper were $15 - 20^{\circ}\text{C}$; ^{drops} current estimates are $10 - 15^{\circ}\text{C}$ in good agreement considering the irreducible uncertainties in the calculations. Both temperature declines are much greater than the difference between current global temperatures and those of the last Ice Age.

Different scientists have different speculative styles, some being much more cautious than others. As long as new ideas are testable and scientists are not overly dogmatic, no harm is done; indeed, considerable progress can be made. In the first four instances I've just mentioned where I was wrong, I was trying to understand a distant world from a few clues in the absence of thorough spacecraft investigations. In the natural course of planetary exploration more data comes in, and we find an army of old ideas plowed down by an armamentarium of new facts. (As for my concerns about the Kuwaiti oil fires, there is at least reason to believe that it led to more careful measurements of the resulting aerosols than ~~might~~ otherwise have been the case.)

Summary I
Science is different from many another human enterprise -- not, of course, in its practitioners sometimes being right and sometimes wrong (which is common to every human activity), but in its passion for framing testable hypotheses, in its search for definitive experiments that confirm or deny ideas, in the vigor of its substantive debate, and in its willingness to abandon ideas that have been found wanting. If we were not aware of our own limitations, though, if we were not acquiring further information, if we were unwilling to do additional, carefully controlled experiments, we would have very little leverage in our quest for the truth.

Scientists with unplumbed biases, proclivities, predispositions, prejudices are in danger of making mistakes. We

might, for example, probe to a certain point at which the data seem to support our prejudices, and then go no further. We might reject, for spurious reasons, contradictory data, or be insufficiently vigilant in examining data that seem to support our prejudices. I have already mentioned how the collective enterprise of science provides significant protection against these fallibilities. But of course prejudices that all humans share are in a different category, and may be more difficult to root out.

Jeremy Bentham, the nineteenth-century British philosopher, described in his Handbook of Political Fallacies why it is difficult: By living together in a state of intimacy with her husband, he says,

many a woman has had. . . a more correct and complete acquaintance with the internal causes by which the conduct of her husband has been determined, than he has had himself. . . By interest, a man is continually prompted to make himself as correctly and completely acquainted as possible with the springs of action which determine the conduct of those upon whom he is more or less dependent for the comfort of his life. But by interest he is at the same time diverted from any close examination into the springs by which his own conduct is determined. From such knowledge he would be more likely to find mortification than satisfaction.

. . . [T]he more closely he looks into the mechanism of his own mind, the less able he is to refer any of the mass of effects produced there to any of these amiable and delightful causes. He finds nothing, therefore, to attract him towards this self-study; he finds much to repel him from it.

. . . This, in any study of his own mental physiology, will always be his first step; and it will commonly be his last also. Why should he look any further? Why take in hand the painful probe? Why undeceive himself, and substitute the whole truth, which would mortify him, for a half-truth which flatters him?

If all the scientists working in a given area are members of a certain gender or ethnic group, they may be insufficiently vigilant about conclusions on the inferiority of the other gender or another ethnic group. Since all scientists we know are humans, conclusions about humanity as the pinnacle of Creation, as the center and meaning of the world, might insidiously become established, because skepticism on this matter tends to be generally resented.

Where the evidence is unconvincing, we can be cautious. But on public policy we often are required to make practical judgments before all the evidence is in. The clock is ticking and we do not have the leisure to wait until the case is ironclad. We must make decisions on the best knowledge and wisdom available, and hope we don't commit a serious error. This skill is by no means the same as the skill of doing good science. The chance of making a mistake in the application of science to public policy is much greater than the error rate in pure science by itself. We should not confuse the two.

~~The postmodernist attack on science -- that it is~~
fundamentally flawed because of subjectivity -- seems misplaced
(perhaps ^{it's} an inappropriate extrapolation from other fields of
knowledge, and from instances where scientists have made
subjective errors). Science has error-correcting machinery built
into it, and we have innumerable examples where widely-held, even
cherished, scientific constructs were discovered wrong and,

however painfully, abandoned. The scientists pick themselves up, dust themselves off, accept the new insight, and move on to a new problem.

Chapter 14

SINGLE VISION

A harmful truth is better than a useful lie.

-- Thomas Mann (1875-1955)

"May God keep us from single vision and Newton's sleep," wrote the poet, painter, and revolutionary, William Blake -- and by Newton's sleep, he seems to have meant Newton's (incomplete) disengagement from mysticism. A common critique of science is that it is too narrow. It rules out of court, beyond serious discourse, a wide range of uplifting images, playful notions, earnest mysticism, and stupefying wonders. Science does not admit, without physical evidence, ghosts, spirits, souls, angels, devils, or dharma bodies of the Buddha. Or alien visitors. ^{American} The psychologist Charles Tart, who believes the evidence for extrasensory perception is compelling, writes:

An important factor in the current popularity of "New Age" ideas is a reaction against the dehumanizing, despiritualizing effects of scientism, the philosophical belief (masquerading as objective science and held with the emotional tenacity of born-again fundamentalism) that we are nothing but material beings. To unthinkingly embrace anything and everything labeled "spiritual" or "psychic" or "New Age" is, of course, foolish, for many of these ideas are factually wrong, however noble or inspiring they are. On the other hand, this New Age interest is a legitimate recognition of some of the realities of human nature: People have always had and continue to have experiences that seem to be "psychic" or "spiritual."

But why should "psychic" experiences challenge the idea that we are made of matter and nothing ^{but} ~~more~~? There is very little

doubt that, in the everyday world, matter (and energy) exist. The evidence is all around us. In contrast, the evidence for something non-material called "spirit" or "soul" is very much in doubt. Of course each of us has a rich internal life. Considering the stupendous complexity of matter, though, how do we know that our internal life is not wholly due to matter? Granted, there is much about human consciousness that we do not fully understand and cannot yet explain in terms of the interaction of neurons. Humans have limitations, and no one knows this better than scientists. But a multitude of aspects of the natural world that were considered miraculous only a few generations ago are now thoroughly understood in terms of physics and chemistry. At least some of the mysteries of today will be comprehensively solved by our descendants. The fact that we cannot now produce a detailed understanding of, say, altered states of consciousness in terms of brain chemistry no more implies the existence of a "spirit world" than a sunflower following the Sun in its apparent motion across the sky was evidence of a literal miracle before we knew about phototropism and plant hormones.

And if the world does not in all respects correspond to our wishes, is this the fault of science, or of those who would impose their wishes on the world? All the mammals -- and many other animals as well -- experience emotions: fear, lust, hope, pain, love, hate, the wish to be led. Humans may brood about the

True, brain lesions can make us ~~forget~~^{lose} major segments of our memory, or convert us from ~~aggressive~~^{manic} to placid, or vice versa; and changes in brain chemistry can make us believe there's a massive conspiracy against us, or make us think we hear the voice of God. But as compelling ~~evidence~~^{testimony} - ["Single Vision" (M, 11/28/94)] ~~as~~^{as} this provides that our personality, character, memory -- if you will, soul -- resides in the matter of the brain, it is easy not to focus on it, to find ways to evade the weight of future more, but there is nothing in our emotions unique to us. ^{the} ~~evidence~~.

On the other hand, no other species does science as much or as well as we. How then can science be "dehumanizing"?

Still, it seems so unfair: We can be born into an abusive family or a reviled ethnic group, or start out with some deformity; we go through life with the deck stacked against us, and then we die, and that's it. ⁷ ~~on~~ ^N nothing but a dreamless and endless sleep. [?] Where's the justice in this? This is stark and brutal and heartless. Shouldn't we have a second chance to live again on a level playing field and a shot at some of the deepest joys of life? How much better if we were born again in circumstances that took account of how well we played out our part in the last life, no matter how stacked against us the deck was then. Or if there were a time of judgment after we die, then, if we did well with the persona we were given and were humble and faithful and all the rest, we might be rewarded with

an infinity of bliss. That's how it would be if the world were ^{adaptive}

^A Further, fear of death, which in some respects is ~~an advantage~~ in the evolutionary struggle for existence, can be maladaptive in main force or even guerrilla warfare. Those cultures that teach an afterlife of rewards for

So the idea of a spiritual part of our nature that survives

death, the notion of an afterlife, ought to be ~~very~~ easy to sell. This is not an issue on which we might anticipate widespread skepticism. People will want to believe it, even if the evidence is meagre to nil. [✓] And if there are powerful social institutions insisting that there is an afterlife, it should be no surprise that dissenters tend to be sparse, quiet, and resented.

heroes -- or even ^{for} those who just did what those in authority told them -- might gain a competitive advantage.

Some Eastern, ^{Christian} and New Age religions and ~~Christian Science~~, and Platonism hold that the world is unreal, suffering, ~~the~~ death illusions; ~~and~~ that nothing really exists except Mind.

and matter itself

["Single Vision" (M, 11/28/94)]

4

There are people who want everything to be possible, to have their reality unconstrained. Our imagination and our needs ~~must~~ cast a wider net, they feel, than the comparatively little that science teaches we may be reasonably sure of. Irritatingly, science claims to set limits ~~not only~~ on what we ^{can do} have done, ~~but~~ on what we might possibly do in the future. Who says we can't travel faster than light? We travelled faster than sound, didn't we? Who's going to stop me, if I have really powerful instruments, from measuring the position and the momentum of an electron simultaneously? Why can't I, if I'm very clever, build a perpetual motion machine "of the first kind" (one that generates more energy than is supplied to it), or a perpetual motion machine "of the second kind" (one that never runs down)? Who dares to set limits on human ingenuity?

In fact, Nature does. In fact, a fairly comprehensive and very brief statement of the laws of Nature is contained in just such a list of prohibited acts. Tellingly, pseudoscience and superstition tend to ^{recognize} ~~place~~ no constraints ⁱⁿ ~~on~~ Nature. Instead, "all things are possible." ^{It} ~~This~~ is a much more hopeful doctrine, however often its adherents have been disappointed and betrayed.

If I dream of being reunited with a dead parent or child, who is to tell me that this didn't really happen? If I have a vision of myself floating in space looking down on the Earth, maybe I was really there; who are some scientists, who didn't even share the experience, to tell me that it's all in my head?

(The prevailing scientific view is that mind is, ^{how we perceive} what the brain does; i.e., ^{it's} a property of the hundred trillion⁰ neural connections in the brain.)

["Single Vision" (M, 11/28/94)]

5

If my religion teaches that it is the inalterable and inerrant word of God that the Universe is 6,000 years old, then scientists are being offensive and impious, as well as mistaken, when they claim it's 10 or 15 billion years old.

* * *

A related complaint is that science is too simple-minded, too "reductionist"; it naively imagines that in the final accounting there will be only a few laws of Nature -- perhaps even rather simple ones -- that explain everything, that the exquisite subtlety of the world, all the snow crystals, spiderweb latticework, spiral galaxies, and flashes of human insight, can ultimately be "reduced" to such laws. Reductionism seems to pay insufficient respect to the complexity of the Universe. It appears to some as a curious hybrid of arrogance and intellectual laziness.

To Isaac Newton -- who in the minds of critics of science personified "single vision" -- it looked like a clockwork Universe. Literally. The regular, predictable orbital motions of the planets around the Sun, or the Moon around the Earth, were described to high precision by essentially the same differential equation that predicts the swing of a pendulum or the oscillation of a spring. We have a tendency today to think we occupy some exalted vantage point, and to pity the poor Newtonians for having

so limited a world view. But within certain reasonable limitations, the same harmonic equations that describe clockwork really do describe the motions of astronomical objects throughout the Universe. This is a profound, not a trivial parallelism.

Of course, the Solar System is not really a clock: There are no gears, and the component parts of the gravitational clockwork ^{do not touch.} ~~are at great distances from one another.~~ Also, the clockwork model breaks down in certain circumstances. Over very long periods of time, ^{gravitational} the tugs of distant worlds -- tugs that you might readily ignore over a few orbits -- can build up, and some little world can go unexpectedly careening out of its accustomed course. However, something like chaotic motion is also known in pendulum clocks; if we displace the bob too far from the perpendicular, a wild and ugly motion ensues.

The astonishing fact is that the same mathematics applies so well to planets and to clocks. It needn't have been this way. We didn't impose it on the Universe. That's the way the Universe is. If this is reductionism, so be it.

Until the middle twentieth century, there had been a strong belief -- among theologians, philosophers, and many biologists -- that life was not "reducible" to the laws of physics and chemistry, that there was a "vital force," an "entelechy" that made living things go. It was impossible to see how mere atoms and molecules could account for the intricacy and elegance, the fitting of form to function, of a living thing. The world's

religions were invoked: God or the gods breathed life, soul-stuff, into inanimate matter.

Even biological materialists entertained reservations; perhaps, if not plant ^{and microbial} and animal souls, some still undiscovered principle of science was needed to understand life. I remember very well that when the molecular structure of DNA and the nature of the genetic code were first elucidated in the 1950s and 1960s, biologists who studied whole organisms accused the new proponents of molecular biology of just such reductionism. ("They'll never understand even a worm with their DNA.") But it is now clear that all life on Earth, every single living thing, has its genetic information encoded in the nucleic acids and employs fundamentally the same codebook to carry out the hereditary instructions. We have found how to read the code. The same few dozen organic molecules are used over and over again in biology for the widest variety of functions. The entire genome of many organisms (including the ^{worm-like nematode,} "worm," C. elegans) has now been mapped. Molecular biologists are busily recording the sequence of three billion nucleotides that specifies how to make a human being. In another decade or two, they'll be done. (Whether the benefits will ultimately exceed the risks seems by no means certain.)

The continuity between atomic physics, molecular chemistry, and that holy of holies, the nature of heredity, has now been established. No new principle of science had to be invoked. It looks as if there are a small number of simple facts which can be

used to understand the enormous intricacy and variety of living things. (Molecular genetics also teaches that each organism has its own particularity.)

Reductionism is even better established in physics and chemistry. We've known for centuries that a handful of comparatively simple laws not only explain^s but quantitatively^{and accurately} predict^s a breathtaking variety of phenomena, not just on Earth but through the entire Universe.

We might have lived in a Universe in which nothing could be understood by a few simple laws, in which Nature was complex beyond our abilities to understand, in which laws that apply on Earth are invalid on Mars, or in a distant quasar. But the evidence -- not the preconceptions, the evidence -- proves otherwise. Luckily for us, we live in a universe in which much can be "reduced" to a small number of comparatively simple laws of Nature. Otherwise we might have lacked the intellectual capacity and grasp to comprehend the world.

Of course, we may make mistakes in applying a reductionist program to science. There may be aspects which, for all we know, are not reducible to a few comparatively simple laws. But in light of the findings of science in the last few centuries, it seems foolish to complain about reductionism. It is not a deficiency but one of the chief triumphs of science.

* * *

This in itself makes religious bureaucrats and believers wary of science.

Many tenets at the hearts of various religions can be tested scientifically. Is the Eucharist in fact, and not just as productive metaphor, the flesh of Jesus Christ, or is it -- chemically, microscopically, and in other ways -- just a wafer? Will the world be destroyed at the end of the ⁵²⁻~~46~~-year Venus cycle unless humans are sacrificed to the gods? * *Does the occasional uncircumcised* Jewish ^a~~men~~ fare worse than ^{his co-religionists} ~~those~~ who abide by the ancient covenant in which God demands a piece of foreskin from every male worshipper? Are there humans populating innumerable other planets, as the Latter Day Saints teach? Were whites created from blacks by a mad scientist, as the Nation of Islam asserts? Would the Sun indeed not rise if the Hindu sacrificial rite is not performed (as we are assured in the Satapatha Brahmana)? Did the Ka'aba at Mecca actually fall from the sky (i.e., is it an iron meteorite)? Do "third-party" prayers -- prayers for the benefit of someone who never knows he or she is being prayed for -- actually work?

Does prayer work at all? Which ones? We've discussed faith healing. What about longevity through prayer? The Victorian statistician, Francis Galton argued that -- other things being equal -- British monarchs ought to be very long-lived, because

* Since this Mesoamerican ritual has not really been practiced for five centuries, we have the perspective to reflect on the tens of thousands of willing and unwilling sacrifices to the Aztec and Mayan gods who consoled themselves that ~~at least~~ they were dying to save the world.

millions of people all over the world daily intoned ~~the~~ ^{stet} heartfelt mantra "God Save the Queen" (or King). Yet, he showed, if anything, they don't live as long as other members of the wealthy and pampered aristocratic class. Tens of millions of people in concert wished (although they did not exactly pray) that Mao Zedong would live "for ten thousand years." Nearly everyone in ancient Egypt exhorted the gods to let the Pharaoh live "forever." These collective prayers failed.

By making pronouncements that are, even if only in principle, testable, religions, however unwillingly, enter the arena of science. ~~This is an additional source of unease about science.~~ Religions can no longer make unchallenged assertions about reality [^] so long as they do not seize secular power, provided they cannot coerce belief.

Of course many mainstream religions -- devoted to reverence, awe, ethics, ritual, and charity -- are in no way challenged by the findings of science. But others, sometimes called conservative or fundamentalist, have chosen to make a stand on matters subject to disproof, and thus have something to fear from science. There is also ^{of confessing past errors} a middle ground -- as with the Roman Catholic Church ^{did in its 1992} acknowledgment that Galileo was right after all, ^{that} and the Earth does revolve around the Sun: three centuries late, but welcome nonetheless.

In theological discussion with religious leaders, I often ask what their response would be if a central tenet of their

faith were disproved by ^{science.} ~~religion.~~ When I put this question to

~~the~~ the current, Fourteenth, Dalai Lama, he ^{as few religious leaders do: in such a case, he said,} unhesitatingly replied ~~that~~ Tibetan Buddhism would have to change.

Even, I ^{asked} ~~proposed~~, if it's a really central tenet, like (I searched for an example) reincarnation?

Even then, he ~~replied.~~ ^{answered.}

However, ^{-- it's} he ~~quickly~~ ^{added} with a twinkle, ~~you're~~ going to ^{be hard} ~~have difficulties~~ disproving reincarnation.

Plainly, the Dalai Lama is right. Religious doctrine that ~~resists disproof or that~~ is immune to disproof has little to fear from science. The ^{grand} ~~great~~ idea of a Creator of the Universe is one such doctrine -- difficult alike to demonstrate or to dismiss, and common to many faiths,

There are other doctrines, interests, and concerns that also worry about what science will find out. Perhaps, they ~~in effect~~ suggest, it's better not to know. If men and women turn out to have different hereditary propensities, won't this be used as an excuse for the former to suppress the latter? If there's a genetic component of violence, might this justify repression of one ethnic group by another, or even precautionary incarceration?

If mental illness is just brain chemistry, doesn't this undermine our efforts to keep a grasp on reality ^{or to be responsible for our actions?} If we are not the special handiwork of the Creator of the Universe, and our basic moral laws are merely invented by fallible lawgivers, isn't our

struggle to maintain an orderly society undermined?

I suggest that in every one of these cases, religious or secular, we are much better off if we know the best available approximation to the truth -- and if we keep before us a keen apprehension of the errors our interest group or belief system has committed in the past. In every case the imagined dire consequences of the truth being generally known are exaggerated. And we are not wise enough to know which lies, or even which shadings of the facts, can competently serve some higher social purpose -- especially in the long run.

Science is often taken to task because it and its products are said to be morally neutral, ethically ambiguous, as readily employed in the service of good as of evil. This is an old indictment. It goes back probably to the flaking of stone tools and the domestication of fire. Since technology has been with our ancestral line from before the first human, since we are a technological species, this problem is not so much one of science as of humans. By this I don't mean that science has no responsibility for the misuse of its findings. It has profound responsibility, and the more powerful its products -- for example, the greater the ability of our technology to alter the global environment -- the greater its responsibility. Sometimes scientists have tried to have it both ways: to take credit for those applications of science that enrich our lives, but to distance themselves from the instruments of death, intentional

and inadvertent, that also trace back to scientific research.

^{Australian}
The philosopher John Passmore writes,

The Spanish Inquisition sought to avoid direct responsibility for the burning of heretics by handing them over to the secular arm; to burn them itself, it piously explained, would be wholly inconsistent with its Christian principles. Few of us would allow the Inquisition thus easily to wipe its hands clean of bloodshed; it knew quite well what would happen. Equally, where the technological application of scientific discoveries is clear and obvious -- as when a scientist works on nerve gases -- he cannot properly claim that such applications are "none of his business," merely on the ground that it is the military forces, not scientists, who use the gases to disable or kill. This is even more obvious when the scientist deliberately offers help to governments, in exchange for funds. If a scientist, or a philosopher, accepts funds from some such body as an office of naval research, then he is cheating if he knows his work will be useless to them and must take some responsibility for the outcome if he knows that it will be useful. He is subject, properly subject, to praise or blame in relation to any innovations which flow from his work.

An important case history is provided by the career of the Hungarian-born physicist Edward Teller. His early contributions ranged from quantum mechanical selection rules and solid state physics to cosmology. It was he who chauffeured Leo Szilard to the vacationing Albert Einstein on Long Island in July 1939 -- a meeting that led to the historic letter from Einstein to President Roosevelt urging, in view of both scientific and political events in Nazi Germany, that the United States develop the atomic bomb. Recruited to work on the Manhattan Project, Teller arrived at Los Alamos and ^{promptly} ~~soon~~ refused to cooperate -- not because he was dismayed at what an atomic bomb might do, but just the opposite: because he wanted to work on a much more

In an admiring 1954 article, Life magazine described his "almost fanatic determination" to build the hydrogen bomb.

→ p. 16

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destructive weapon, the hydrogen bomb. (While there is a practical upper limit on the yield or destructive energy of an atomic bomb, there is no such limit for the hydrogen bomb. But the hydrogen bomb needs an atomic bomb as trigger.)

After the atomic bomb was invented, after Germany and Japan surrendered, after the war was over, Teller remained a persistent advocate of what became called "The Super." Concern about the rebuilding Soviet Union under Stalin and the national paranoia in America called McCarthyism eased Teller's way. A substantial obstacle was offered, though, in the person of J. Robert Oppenheimer, the director of the Manhattan Project and later the chairman of the General Advisory Committee to the post-war Atomic Energy Commission. Teller provided key information to the government, and critical testimony at a government hearing, questioning Oppenheimer's loyalty to the United States. Teller's involvement is generally thought to have played a major role in what came after: Although Oppenheimer's loyalty was not exactly impugned by the review board, somehow his security clearance was denied, he was retired from the A.E.C., and Teller's way to The Super was greased.

The technique for making a thermonuclear weapon is generally attributed to Teller and the mathematician Stanislas Ulam, ~~but~~ Hans Bethe, the Nobel Laureate physicist who headed the Theoretical Division at the Manhattan Project and who played a major role in the development of ^{both the atomic and} the hydrogen bomb, attests that

~~been exploded in~~

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^{original}
Teller's suggestion was flawed, and that ^{the work of many people was} quite another solution ~~quite another solution~~
^{necessary to bring} brought the hydrogen bomb to reality. With fundamental technical contributions from a young physicist named Richard Garwin, the first U.S. thermonuclear weapon was exploded in 1952 ~~[check]~~.
The first Soviet ^{hydrogen bomb} ~~thermonuclear explosion~~ followed one year ~~although a thermonuclear "device" -- for mass use -- had~~
~~[check]~~ later. There has been debate on whether the Soviet Union would have developed a thermonuclear weapon if the United States had not, and whether a U.S. thermonuclear weapon was even needed to deter Soviet use of their hydrogen bomb -- since the U.S. by then possessed a substantial arsenal of fission weapons.

From my point of view, the consequences of global nuclear war became much more dangerous with the invention of the hydrogen bomb, because airbursts of thermonuclear weapons are much more capable of burning cities, generating vast amounts of smoke, and inducing global-scale nuclear winter. The long-term consequences of global thermonuclear war have been estimated by an international team of 200 scientists, who concluded that through nuclear winter global civilization and most of the people on Earth -- including those far from the northern mid-latitude target zone -- would be at risk, mainly from starvation. If large-scale nuclear war ever occurs, with cities targeted, the effort of Edward Teller and his colleagues in the United States (and the counterpart team headed by Andrei Sakharov in the Soviet Union) might be responsible for lowering the curtain on the human future. The hydrogen bomb is by far the most horrific weapon

He has been a vigorous proponent of the safety and cost-effectiveness of fission nuclear power plants, ~~and~~ claiming himself to be the only casualty of the Three Mile Island nuclear accident in ["Single Vision" (M, 11/28/94)] Pennsylvania in 1979; he had a heart attack, he says, ~~and~~ debating the issue.

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It seems to me impossible for any normal human being to be untroubled by ^{helping to make} such an invention, even putting nuclear winter aside. The stresses on those who take credit for the contrivance ^{conscious or unconscious,} must be very great. Whatever his actual contributions, Edward Teller has been widely ^{described as} called "the father" of the hydrogen bomb.

From p. 14 Much of his subsequent career can, I think, be understood as an attempt to justify ^{what he begat} the ~~super~~. He has ^{contended,} argued, not implausibly, that hydrogen bombs keep the peace, because the consequences of warfare between nuclear ~~super~~ ^{nuclear-armed} powers are now too dangerous. But all such arguments assume that the nations are and always will be, without exception, rational actors, and that bouts of anger and revenge and madness never overtake their leaders (or military ^{and secret police} officers in charge of ^{nuclear} such weapons). In the century of Hitler and Stalin, this seems ingenuous. ^{that ratifying the treaty would} "give away the future safety of ^{our country}"

Teller was a major force in preventing a comprehensive treaty banning nuclear weapons tests. He made it much more difficult to accomplish the 1963 Limited (above-ground) Test Ban Treaty ~~for which Linus Pauling had passionately argued~~. Teller's argument that above-ground testing was essential to ^{and "improve"} maintain the nuclear arsenals has proven specious.

Teller advocated ^{exploding} nuclear weapons to dredge harbors and canals, to obliterate troublesome mountains, to do heavy earth-moving ~~in general~~. When he proposed such a scheme to Queen Frederika of Greece, she is said to have responded, "Thank you,

Dr. Teller, but Greece has enough quaint ruins already." Want to test Einstein's general relativity? Then explode a nuclear weapon on the far side of the Sun, Teller proposed. Want to understand the chemical composition of the Moon? Then fly a hydrogen bomb to the Moon, explode it, and examine the spectrum of the flash and fireball.

When nuclear winter was discovered in 1983, Teller was quick to argue both (1) that the physics was mistaken, and (2) that the discovery had been made years earlier under his tutelage at the Lawrence Livermore National Laboratory. There is in fact no evidence for ^{such a} ~~the~~ prior discovery, and considerable evidence that those in every nation charged to inform their national leaders of the effects of nuclear weapons had consistently overlooked nuclear winter. But if Teller is right ~~that it had much earlier been discovered~~, then is it ~~not~~ unconscionable of him not to have disclosed it to the affected parties -- the citizens and leaders of his nation and the world? As in the movie Dr. Strangelove, classifying the ultimate weapon -- so no one knows that it exists or what it can do -- is the ultimate absurdity.

Also in the 1980s, Teller sold President Ronald Reagan the notion of Star Wars -- called by them the "Strategic Defense Initiative," ^{SDI.} Reagan was not known for the depth ~~or skepticism~~ of his thinking. He seems to have believed a highly imaginative story of Teller's that it was possible to build a desk-sized ^{hydrogen-bomb-driven X-ray laser} orbiting ~~weapon~~ that would destroy 10,000 Soviet warheads in

flight, and provide genuine protection for the citizens of the United States in case of global thermonuclear war.

It is claimed by apologists for the Reagan Administration that, whatever the exaggerations in capability, some of it intentional, SDI was responsible for the collapse of the Soviet Union. There is no serious evidence in support of this contention. Andrei Sakharov, Yevgeny Velikhov, Roald Sagdeev, and other scientists who advised President Mikhail Gorbachev made it clear that if the United States really went ahead with a Star Wars program, the safest and cheapest Soviet response would be merely to ^{augment} ~~increase~~ the arsenal of existing Soviet nuclear weapons and delivery systems. In this way Star Wars could have increased, not decreased, the peril of thermonuclear war. At any rate, Soviet expenditures on space-based defenses against American nuclear missiles were ^{comparatively paltry} ~~hardly~~ of a magnitude to trigger a collapse of the Soviet economy.

Ten thousand American scientists and engineers publicly ^{pledged} ~~vowed~~ they would not work on Star Wars or accept money from ^{the} SDI ~~Organization~~. This provides an example of widespread and courageous non-cooperation by scientists ^(at some conceivable personal cost) with a democratic government that had, temporarily at least, lost its way.

Teller has also advocated the development of burrowing nuclear warheads -- so underground command centers and deeply buried shelters for ^{leadership (and their} ~~the leadership~~ of an

adversary nation might be ^{due down to and} easily wiped out; and 0.1-kiloton nuclear warheads ^{that} which would saturate an enemy country, obliterating its infrastructure "without a single casualty": Civilians would be warned in advance.

As I write, Edward Teller -- still vigorous and retaining considerable intellectual powers into his ^{late} ~~mid~~ eighties -- has mounted a campaign to develop and explode new generations of very high-yield thermonuclear weapons in space, in order to destroy or deflect asteroids that might be on collision trajectories with the Earth. I have elsewhere described** the extreme dangers involved in premature experimentation with orbits of nearby asteroids. He has always been a fervent anti-communist and technophile,

I have met privately ^{and I have} with Dr. Teller, ^{while} and have debated him in at scientific meetings, in the national media, and in a closed session of Congress. We ^{we} have had strong disagreements, especially on Star Wars, nuclear winter, and asteroid defense.

Perhaps all this has colored my view of him. ^{Although} But as I look back over his life, it seems to me I see a desperate attempt to justify his advocacy of the hydrogen bomb. ^{Its effects aren't as bad as you might think.} It can be used to defend the world from other hydrogen bombs, for science, for civil engineering, to defend the population of the United States against an enemy's thermonuclear weapons, to wage war humanely, to save the planet from random hazards from space. Somehow,

** Carl Sagan, Pale Blue Dot (New York: Random House, 1994); ~~see especially Chapter 18, "The Marsh of Camarina," pp. 309-327.~~

somewhere, he wants to believe, thermonuclear weapons ^{and he,} will be acknowledged by the human species as its potential savior rather than its potential destroyer.

When scientific research provides fallible nations and political leaders with formidable, indeed awesome powers, many dangers present themselves: One is that some of the scientists involved may lose all but a superficial semblance of objectivity. As always, power corrupts, ~~and absolute power corrupts absolutely.~~ In this circumstance, the institution of secrecy is especially pernicious, and the checks and balances of a democracy especially valuable. The most open and vigorous debate is often the only protection against the most perilous misuse of technology. The critical piece of the counterargument may be something obvious -- that many scientists or even lay people could come up with [✓] provided there were no penalties for speaking out. Or it might be something more subtle, something that would be noted by an obscure graduate student in some locale remote from Washington, DC -- who, if the arguments were closely held and highly secret, would never have the opportunity to address the issue.

But what realm of human endeavor ^{* * *} is not morally ambiguous? Even folk institutions that purport to give us advice on behavior and ethics seem fraught with contradictions. Consider aphorisms: Haste makes waste. Yes, but a stitch in time saves nine. Better safe than sorry; but nothing ventured, nothing gained. Where

A penny saved is a penny earned; but you can't take it with you.

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Instead, Joshua "destroyed all that breathed, as the ^{2d} Lord God of Israel commanded (Joshua 10:40).

there's smoke, there's fire; but you can't tell a book by its cover. He who hesitates is lost; but fools rush in where angels fear to tread. Two heads are better than one; but too many cooks spoil the broth. There was a time when people planned or justified their actions on the basis of such contradictory platitudes. What is the ^{moral} responsibility of the aphorist?

¶ Or consider the mainstream religions.

We are enjoined in Micah to do justly and love mercy; in Exodus we are forbidden to commit murder; and in the ~~Synoptic~~ Gospels we are commanded to love our neighbor as ourselves. Yet think of the rivers of blood spilled by the followers of the books in which these ^{well-meaning} ~~divine~~ exhortations are embedded.

and in the second half of Numbers

In Joshua is celebrated the mass murder of men, women, children, down to the domestic animals in city after city across the whole land of Canaan. Jericho ^{is} ~~was~~ obliterated in a kherem, a "holy war." The only justification offered for this slaughter is the mass murderers' claim that, in exchange for circumcising their sons and adopting a particular set of rituals, their ancestors were long before promised that this land was theirs ^{Land}. Not a hint of self-reproach, not a muttering of patriarchal or divine disquiet at these genocidal actions can be dug out of holy scripture. And these events are not incidental, but central to the narrative thrust of the Old Testament. Moreover, the Bible is filled with similar stories of genocide and sexual enslavement, with hardly a pang of moral concern.

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to the most refined
love, courage and
self-sacrifice.

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It is properly said that the Devil can "quote Scripture to his purpose." The Bible is full of so many stories of contradictory moral purpose that every generation can find scriptural justification for nearly any action it proposes, ^{-- from incest, slavery and mass murder} And this moral multiple personality disorder is hardly restricted to Judaism and Christianity. You can find it deeply within Islam, the Hindu tradition, and nearly all world religions. Perhaps it is not so much scientists as people who are morally ambiguous.

Among the !Kung San hunter-gatherers of the Kalahari Desert, when two men, perhaps testosterone-inflamed, would begin to argue, the women would reach for the ^{if} poison arrows and put them out of harm's way. Today our poisoned ~~poisoned~~ arrows could destroy the global civilization and just possibly annihilate our species. The price of moral ambiguity is now too high. For this reason -- and not because of its approach to knowledge -- the ethical responsibility of scientists must also be high, extraordinarily high, unprecedentedly high. ⁴ It is the particular task of scientists, I believe, to alert the public ^{to} on possible dangers, especially those emanating from science or foreseeable through the use of science.)

Clearly such warnings need to be judicious and not more flamboyant than the dangers require; but if we must make errors, given the stakes, they should be on the side of ~~caution~~ ^{safety}.

Chapter 15

THE MARRIAGE OF SKEPTICISM AND WONDER

Nothing is too wonderful to be true.

-- remark attributed to Michael Faraday (1791-1867)

Insight, untested and unsupported, is an insufficient guarantee of truth.

-- Bertrand Russell, Mysticism and Logic (1929)

When we are asked to swear in American (and British) courts of law -- that we will tell "the truth, the whole truth, and nothing but the truth" -- we are being asked the impossible. It is simply beyond our powers. Our memories are fallible; even scientific truth is merely an approximation; and we are ignorant about most of the Universe. Despite all that, a life may depend on our testimony. To swear to tell the truth, the whole truth, and nothing but the truth to the limit of our abilities is a fair request. Without the qualifying phrase, though, it's simply out of touch. But such a qualification, however consonant with human reality, is unacceptable to any legal system. If everyone tells the truth only to a degree determined by individual judgment, it is feared, then ~~all sorts of~~ incriminating or awkward facts might be withheld, events shaded, culpability hidden, responsibilities ~~evaded~~^x, and justice denied. So the law strives for an impossible standard of accuracy, and we do the best we can.

In the jury selection process, the court needs to be reassured that the verdict will be based on evidence. It makes heroic efforts to weed out bias. It is aware of human imperfection. Does the potential juror personally know the district attorney, or the prosecutor, or the defense attorney? What about other jurors? Has she formed an opinion about this case not from the facts laid out in court but from pre-trial publicity? Will she assign evidence from police officers greater or lesser weight than evidence from ~~the defendant's~~ ^{for the defense?} witnesses? Is she biased against the defendant's ethnic group? Does the potential juror live in the neighborhood where the crimes were committed, and might that influence her judgment? Does she have a scientific background about matters on which expert witnesses will testify? Are any of her relatives or close family members employed in law enforcement or criminal law? Has she herself ever had any run-ins with law enforcement officers ^{that} ~~which~~ might influence her judgment in the trial? Was any close friend or relative ever arrested on a similar charge?

The American system of jurisprudence recognizes that a wide range of factors, predispositions, prejudices, and experiences might cloud our judgment, ^{or} ~~might~~ affect our objectivity -- sometimes even without our knowing it. It goes to great, ^{perhaps} ~~maybe~~ even extravagant, lengths to protect the process of judgment in a criminal trial from the human weaknesses of those who must decide on innocence or guilt. Even then, of course, the process

sometimes fails.

Why would we settle for anything less when interrogating the natural world, or when attempting to decide on vital matters of politics, economics, religion, and ethics?

* * *

If it is to be applied consistently, science imposes, in exchange for its manifold gifts, a certain onerous burden: We are enjoined, no matter how uncomfortable it might be, to consider ourselves scientifically -- not to ~~believe~~^{accept uncritically} whatever we're told; to surmount as best we can our hopes, conceits, and unexamined beliefs; to view ourselves as we really are. Can we conscientiously and courageously follow planetary motion or bacterial genetics wherever the search may lead, but declare the origin of matter or human behavior off-limits? Because its explanatory power is so great, once you get the hang of scientific reasoning you're eager to apply it everywhere. However, in the course of looking deeply within ourselves, we may challenge notions that give comfort before the terrors of the world.

In a life short and uncertain, it seems heartless to deprive people of the consolation of faith when science cannot remedy their anguish. Of course, those who cannot bear the burden of science are free to ignore its precepts. But we cannot have

science in bits and pieces, applying it where we feel safe and ignoring it where we feel threatened.

Have I ever heard a skeptic wax superior and contemptuous? Certainly. I've even ^{sometimes} heard, to my retrospective dismay, that unpleasant tone in my own voice. There are human imperfections on both sides of this issue.

Even when it's applied sensitively, scientific skepticism may come across as arrogant, heartless, and dismissive of the feelings and deeply-held beliefs of others. And, it must be said, some scientists and dedicated skeptics apply this tool as a blunt instrument, with little finesse. Sometimes it looks as if the skeptical conclusion came first, that contentions were dismissed before, not after, the evidence was examined. All of us cherish our beliefs. They are, to a degree, self-defining. When someone comes along who rejects our belief system as insufficiently well based -- or who, like Socrates, merely asks embarrassing questions that we haven't thought of, or demonstrates that we've swept key underlying assumptions under the rug -- it becomes much more than a search for knowledge. It feels like a personal assault.

The scientist who first proposed to consecrate doubt as a prime virtue of the inquiring mind made it clear that it was a tool and not an end in itself. René Descartes wrote,

I did not imitate the skeptics, who doubt only for doubting's sake, and pretend to be always undecided; on the contrary, my whole intention was to arrive at a certainty, and to dig away the drift and the sand until I reached the

rock or the clay beneath.

In the way that skepticism is sometimes applied to issues of public concern, there is a tendency to belittle, to condescend, to ignore the fact that, deluded or not, supporters of superstition and pseudoscience are real human beings with real feelings; that they, like ^{the skeptics,} ~~we~~, are trying to figure out how the world works and what our role in it might be. Their motives are in many cases consonant with science. If their culture has not given them all the tools they need to pursue this great quest, let us temper our criticism with kindness. None of us is fully equipped. All of us are fallible.

One of my favorite cartoons shows a fortune-teller scrutinizing the mark's palm and gravely concluding, "You are very gullible." Suppose, I sometimes imagine, I wasn't steeped in the virtues of scientific skepticism, and along came someone who claims himself able to put me in touch with my parents. Suppose he's clever, and found out something about their lives and personalities, and is good at faking voices, and insists on a darkened room and incense and all of that. I could see being swept away, willing to ^{exchange} ~~surrender~~ some chastity of the intellect ~~in exchange~~ for the reassurance that my mother and father never really died.

Would you think less of me if I fell for it? Even if I had never been educated about skepticism? Even if I had no idea of ^{the} ~~its~~ ^{of skepticism,} powers, but instead believed that it was grumpy and negative

and rejecting of everything humane? Couldn't you understand how
I might ^{let myself} be conned?

* * *

The Committee on Scientific Investigation of Claims of the Paranormal is an organization of scientists, academics, magicians, and others dedicated to skeptical scrutiny of candidate or emerging pseudosciences. It was founded by the University of Buffalo philosopher Paul Kurtz in 1976. I've been affiliated with it since its beginning. Its acronym, CSICOP, is pronounced "sci-cop" -- as if it's an organization of scientists performing a police function. Those wounded by CSICOP's analyses sometimes make just such a complaint: It is hostile to every new idea, they say, will go to absurd lengths in its knee-jerk debunking, is a vigilante organization, a New Inquisition, and so on.

CSICOP is imperfect. In certain cases such a critique is to some degree justified. But from my point of view CSICOP serves an important social function: It is a well-known organization to which media can apply when they wish to hear the other side of the story -- especially when some amazing claim of pseudoscience ~~appears that~~ is adjudged newsworthy. It used to be -- and for much of the global news media it still is -- that every levitating guru, visiting alien, channeler, and faith healer,

when covered by the media, would be treated nonsubstantively and uncritically. There would be no institutional memory at the television studio or newspaper or magazine about other, similar claims shown to be scams. CSICOP (83 percent of its members have a college degree, 27 percent a doctorate) represents a counterbalance -- although not yet nearly effective enough -- to the pseudoscience gullibility that seems second nature to so much of the media.

CSICOP publishes a monthly periodical called The Skeptical Inquirer. On the day it arrives, I ~~always~~ take it home from the office and pore through its pages, wondering what new misunderstandings will be revealed. I'm always amazed that there's still another subject that I never thought of. Crop circles! Aliens have come and made perfect circles and mathematical messages. . . in wheat! Who would have thought it? So unlikely an artistic medium. Or they've come and eviscerated cows -- on a large scale, systematically. Farmers are furious. At first, I'm impressed by the depths of inventiveness of these stories. But then, on more sober reflection, it always strikes me how dull and routine these accounts are; what a compilation of stale ideas, chauvinisms, hopes and fears dressed up as facts. The contentions, from this point of view, are suspect on their face. ~~In almost every case, I think:~~ That's all they can imagine the extraterrestrials doing. . . making circles in wheat? What a failure of the imagination! *With every issue, another dose is revealed and criticized.*

of pseudoscience

And yet, the chief deficiency I see in the skeptical movement is in its polarization: Us vs. Them -- the sense that we have a monopoly on the truth; that those other people who believe in all these stupid doctrines are morons; that if you're sensible, you'll listen to us; and if not, you're beyond redemption. This is non-constructive. It does not get the message across. It condemns the skeptics to permanent minority status; whereas, an approach that from the beginning acknowledges the human roots of pseudoscience and superstition might be much more widely accepted.

If we understand this, then of course we have compassion for the abductees, or those who dare not leave home without consulting their horoscopes, or those transfixed by Atlantean crystals. And such compassion for kindred spirits in a common quest also works to make science and the scientific method more attractive, especially to the young.

Many pseudoscientific and New Age belief systems emerge out of dissatisfaction with conventional values and perspectives -- and are therefore themselves a kind of skepticism. David Hess (in Science and the New Age) argues that

the world of paranormal beliefs and practices cannot be reduced to cranks, crackpots, and charlatans. A large number of sincere people are exploring alternative approaches to questions of personal meaning, spirituality, healing, and paranormal experience in general. To the skeptic, their quest may ultimately rest on a delusion, but debunking is hardly likely to be an effective rhetorical device for their rationalist project of getting [people] to recognize what appears to the skeptic as mistaken or magical thinking.

. . . [T]he skeptic might take a clue from cultural

anthropology and develop a more sophisticated skepticism by understanding alternative belief systems from the perspective of the people who hold them and by situating these beliefs in their historical, social, and cultural contexts. As a result, the world of the paranormal may appear less as a silly turn toward irrationalism and more as an idiom through which segments of society express their conflicts, dilemmas, and identities. . .

To the extent that skeptics have a psychological or sociological theory of New Age beliefs, it tends to be very simplistic: paranormal beliefs are "comforting" to people who cannot handle the reality of an atheistic universe, or their beliefs are the product of an irresponsible media that is not encouraging the public to think critically. . .

But Hess's just criticism promptly deteriorates into complaints that parapsychologists "have had their careers ruined by skeptical colleagues," and that skeptics exhibit "a kind of religious zeal to defend the materialistic and atheistic world view that smacks of what has been called 'scientific fundamentalism' or 'irrational rationalism.'"

This is a common but to me deeply mysterious -- indeed, occult -- complaint. Again, we know ^{a great deal about} ~~of~~ ^{and properties} the existence of matter. If a given phenomenon can be understood through matter and energy, why should we hypothesize that something else -- something for which there is as yet no other good evidence -- is responsible? Yet the complaint persists: Skeptics won't accept that there's an invisible fire-breathing dragon in ^{the} ~~my~~ garage because they're all atheistic materialists.

In Science in the New Age, skepticism is discussed, but it is not understood, and it is certainly not practiced. All sorts of paranormal claims are quoted, skeptics are "deconstructed," but you can never learn from reading it that there are ways to

decide whether New Age and parapsychological claims to knowledge are ^{promising} ~~true~~ or false. It's all, as in the standard postmodernist texts, a matter of how strongly people feel and what their biases may be.

Robert Anton Wilson (in The New Inquisition: Irrational Rationalism and the Citadel of Science [Phoenix: Falcon Press, 1986]) describes skeptics as the "New Inquisition." But no skeptic is ^{to my knowledge} ~~compelling~~ ^{ling} belief. All that's happening is that some doctrines and methods are being criticized -- at the worst, ridiculed -- in magazines like The Skeptical Inquirer with circulations of a few tens of thousands. New Agers are not much ^{nor whipped for having visions,} being called up ^(criminal) before tribunals, and they are certainly not being burned at the stake. Why fear a little criticism? Aren't you interested, Mr. Wilson, to see how well you ^{best} beliefs hold up against the ^{the} ~~most withering~~ counterarguments ~~that~~ skeptics can muster?

* * *

Perhaps one percent of the time, someone who has an idea that smells, feels, and looks indistinguishable from the usual run of pseudoscience will turn out to be right. ^{Maybe} Some undiscovered reptile left over from the Cretaceous period will ^{be found} ~~turn out~~ indeed to be living in Loch Ness or the Congo Republic; or we will find artifacts of an advanced, non-human species

elsewhere in the Solar System. At the time of writing there are three claims in the ESP field which ^eare, in my opinion, deserving ^{by thought alone} of serious study: (1) that humans can affect random number generators; (2) that people under mild sensory deprivation can receive thoughts or images "projected" at them; and (3) that young children sometimes report the details of a previous life, which upon checking turn out to be accurate and which they could not have known about in any other way. I pick these ^{claims} ~~examples~~ not because I think they are likely to be ^{valid} true (I don't), but as ^{The last three have some disputed at least some, although still dubious exper-} examples of contentions that might be true. Of course, I could ^{mental} be ~~completely~~ wrong. ~~In many cases you can't tell what's true and what's false by a superficial glance. You must examine the evidence, if there is any. Sometimes in our haste to dismiss we use unworthy arguments.~~ ^{support.}

In the middle 1970s an astronomer I admire put together a modest manifesto called "Objections to Astrology" and asked me to endorse it. I struggled with his wording, ^{and} ~~but~~ in the end found myself unable to sign -- not because I thought astrology has any validity whatever, but because I felt (and still feel) that the tone of the statement was authoritarian. It criticized astrology for having origins shrouded in superstition. But this is true as well for religion, chemistry, medicine, and astronomy, to mention only four. The issue is not what faltering and rudimentary knowledge astrology came from, but what is its present status. Then there was speculation on the psychological motivations of

those who believe in astrology. These motivations -- for example, the feeling of powerlessness in a complex and difficult world -- might explain why astrology is not generally given the skeptical scrutiny it deserves, but is quite peripheral to the issue of its validity.

The statement stressed that we can think of no mechanism by which astrology could work. This is certainly a relevant point -- I've used it, for example, in Cosmos -- but by itself it is unconvincing. No mechanism was known, ~~for example~~, for continental drift (now called plate tectonics) when it was ~~first~~ ^{first quarter of the twentieth century.} proposed by Alfred Wegener in the ~~1920s and '30s~~. The notion was roundly dismissed by all the great geophysicists, who were certain that continents were fixed, not floating on anything, and therefore unable to "drift." Instead, the key twentieth-century idea in geophysics turns out to be plate tectonics; we now understand that continental plates can indeed float and "drift" (or better, be carried by a kind of conveyor belt driven by the great heat engine of the Earth's interior), and all those great geophysicists were simply wrong. Objections to pseudoscience on the grounds of unavailable mechanism can be mistaken -- although if the contentions violate well-established laws of physics, such objections of course carry great weight.

Statements challenging borderline, folk, or pseudoscientific beliefs in an authoritarian voice can do more harm than good. They never convince those who are flirting with pseudoscience,

but seem to confirm their impression that scientists are rigid, closed-minded, and dogmatic. ~~In my view~~ there is no way to approach such subjects except substantively.

Many valid criticisms of astrology can be formulated in a few sentences: for example, its acceptance of precession of the equinoxes in announcing an "Age of Aquarius" and its rejection of precession of the equinoxes in casting horoscopes; its neglect of atmospheric refraction; its list of supposedly significant celestial objects that is ^{mainly} ~~strangely~~ limited to optical frequency sources known to Ptolemy in the second century A.D., ~~and that~~ ^{ing} ignores an enormous variety of new astronomical objects discovered since ~~and at other frequencies~~; inconsistent requirements for detailed information on the time as compared to the latitude and longitude of birth; the failure of astrology to pass the identical-twin test; the major differences in horoscopes cast from identical birth information by different astrologers; and the absence of demonstrated correlation between ~~cold-reading~~ ~~of~~ horoscopes and such psychological tests as the Minnesota Multiphasic Personality Inventory.

What I would have signed is a statement describing and refuting the principal tenets of astrological belief. Such a statement would have been far more persuasive than what was actually circulated and published. But astrology today seems more popular than ever. A quarter of all Americans, according to opinion polls, "believe" in astrology. There are perhaps ten

times more astrologers than astronomers in the United States; in France there are more astrologers than Roman Catholic clergy. No stuffy dismissal by a gaggle of scientists makes contact with the social needs that astrology -- no matter how invalid it is -- addresses, and science does not.

From pp. 12-13

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As I've tried to stress, at the heart of science is an essential tension between two seemingly contradictory attitudes -- an openness to new ideas, no matter how bizarre or counterintuitive, and the most ruthlessly skeptical scrutiny of all ideas, old and new. This is how deep truths are winnowed from deep nonsense. Of course, scientists make mistakes, but there is a built-in error-correcting mechanism: The collective enterprise of creative thinking and skeptical thinking working together keeps the field on track. Those two seemingly contradictory attitudes are, though, in some tension.

Consider this claim: As I walk along, time -- as measured by my wristwatch and my aging process -- slows down. Also, I shrink in the direction of motion. Also, I get more massive. Who has ever witnessed such a thing? It's easy to dismiss it out of hand. Here's another: ~~Two atoms, bound together, can be oriented up-down or left-right, but they are absolutely prohibited, with no exceptions, from being in any intermediate~~ *throughout the Universe,* *Matter and antimatter are all the time,* *being created from nothing*

~~position~~ [check]. Here's a third: Once in a very great while, your car will spontaneously ooze through the brick wall of your garage and be found the next morning on the street. They're all absurd! But the first is a statement of special relativity, and the other two are consequences of quantum mechanics ^{(vacuum} ~~(angular~~ ^{fluctuations} quantization [check] and barrier tunneling,* they're called). Like it or not, that's the way the world is. If you insist it's ridiculous, you'll be forever closed to some of the major findings on the rules that govern the Universe.

If you're only skeptical, then no new ideas make it through to you. You never learn anything. You become a crochety misanthrope convinced that nonsense is ruling the world. (There is, of course, much data to support you.) Since real discoveries at the borderlines of pseudoscience are rare, experience will tend to confirm your grumpiness. But every now and then a new idea turns out to be on the mark, valid and wonderful. If you are too resolutely and uncompromisingly skeptical, you are going to miss (or resent) the transforming discoveries in science, and either way you will be obstructing understanding and progress. Mere skepticism is not enough.

~~But~~ ^A at the same time, science requires the most vigorous and uncompromising skepticism, because the vast majority of ideas are simply wrong, and the only way to winnow the wheat from the chaff

*The average waiting time per ooze is much longer than the age of the Universe since the Big Bang. But, however improbable, in principle it might happen tomorrow.

is by critical experiment and analysis. If you are open to the point of gullibility and have not a microgram of skeptical sense in you, then you cannot distinguish the promising ideas from the worthless ones. Uncritically accepting every proffered notion, idea, and hypothesis is tantamount to knowing nothing. Ideas contradict one another; only through skeptical scrutiny can we decide among them. Some ideas really are better than others.

The judicious mix of these two modes of thought is central to the success of science. Good scientists do both. On their own, talking to themselves, they churn up huge numbers of new ideas, and criticize them ^{systematically} ~~doggedly~~. Most of the ideas never make it to the outside world. Only those that pass a rigorous self-filtration make it out to be criticized by the rest of the scientific community.

Because of this dogged mutual and self-criticism, and the proper reliance on experiment as the arbiter between contending hypotheses, many scientists tend to be diffident about describing their own sense of wonder at the dawning of a wild surmise. This is a pity, because these rare exultant moments of discovery demystify and humanize the scientific endeavor.

It sometimes happens that ideas that are accepted by everybody turn out to be partially wrong, or at least superseded by ideas of greater generality. It often happens that scientists say, "You know that's a good argument; I guess my position is mistaken" -- or words to that effect -- and then actually change

their minds. You never hear that old view from them again. They really do it. It doesn't happen as often as it should, because scientists are human, change is sometimes painful, and we tend to get our opinions and our identities confused. But it happens every day. I can't recall the last time something like that happened in politics or religion; practitioners of those fields sometimes change their minds, but rarely because a ^{substantive} new argument has been presented (except the argument that the old doctrine is becoming unpopular).

No one can be entirely open or completely skeptical. We all must draw the line somewhere. An ancient Chinese proverb advises, "Better to be too credulous than too skeptical," but this is from an extremely conservative society in which the rulers had a powerful vested interest in not being challenged. Most scientists, I believe, would say, "Better to be too skeptical than too credulous." But neither is easy. Responsible, thoroughgoing, rigorous skepticism requires a hardnosed habit of thought that takes practice and training to master. Credulousness -- I think a better word here is "openness" or "wonder" -- does not come easily either. If we really are to be open to counterintuitive ideas in physics or social organization or anything else, we must grasp those ideas. It means nothing to be open to a proposition we don't understand.

Both skepticism and wonder are skills that need honing and practice. Their harmonious marriage within the mind of every

schoolchild ought to be a principal goal of public education. I'd love to see such a domestic felicity portrayed in the media, television especially: a community of people really working the mix -- full of wonder, generously open to every notion, dismissing nothing except for good reason, but at the same time, and as second nature, demanding stringent standards of evidence -- and these standards applied with at least as much rigor to what they hold dear as to what they are tempted to reject with impunity. As my parents used to say, that'll be the day.

[M, 11/28/94]

Chapter 16

NO SUCH THING AS A DUMB QUESTION

So we keep asking, over and over,
Until a handful of earth
Stops our mouths --
But is that an answer?

-- Heinrich Heine, "Lazarus" (1854)

In East Africa, in the records of the rocks dating back to about a million years ago, you can find a sequence of worked tools that our ancestors designed and executed. Their lives depended on making and using these tools. This was, of course, Stone Age technology. Stones were used for chipping, flaking, cutting, carving. Although there are many ways of making stone tools, what is remarkable is that in a given site for enormous periods of time the tools are fashioned in the same way -- which means that there must have been educational institutions hundreds of thousands of years ago, even if they were mostly young people apprenticed to experts. There must have been the equivalent of professors and students, laboratory courses, examinations, failing grades, graduation ceremonies, and postgraduate education.

When the training is unchanged for immense periods of time, intact traditions are passed on to the next generation. But when *what needs to be learned* ~~the learning~~ changes quickly, especially in the course of a single generation, it becomes much harder to know what to teach

and how to teach it. Then, students have less respect for their teachers. Teachers despair at how educational standards have deteriorated, and how lackadaisical students have become. In such a case, ~~of~~ a world in transition, students and teachers both need to teach themselves one essential skill -- learning how to learn.

* * *

Every now and then, I'm lucky enough to teach a kindergarten or first grade class. Many of these children are natural-born scientists. They're curious, intellectually vigorous; provocative and insightful questions bubble out of them. They exhibit enormous enthusiasm for science. I'm asked follow-up questions. They've never heard of the notion of a "dumb question." But when I talk to high school seniors, I find something different. They memorize "facts." By and large, though, the joy of discovery, the life behind those facts, has gone out of them. They're worried about asking "dumb" questions; they're willing to accept inadequate answers; they don't pose follow-up questions; the room is awash with sidelong glances to judge, second-by-second, the approval of their peers. They come to class with their questions written out on pieces of paper, which they surreptitiously examine, waiting their turn and oblivious of whatever discussion their peers are at this moment

engaged in.

Something has happened between first and twelfth grade, and it's not just puberty. I'd guess that it's partly peer pressure not to excel (except in sports); partly that the society teaches short-term gratification; partly the impression that science or mathematics won't buy you a sports car; partly that so little is expected of students; and partly that there are so few rewards or role models for intelligent discussion of science and technology -- or even for learning for its own sake. Those few who remain interested are vilified as "nerds."

But there's something else: I find many adults are put off when children pose scientific questions. Why is the Moon round? they ask. Why is grass green? What is a dream? How deep can you dig a hole? When is the world's birthday? Why do we have toes? Too many teachers and parents answer with irritation or ridicule, or quickly move on to something else: "What did you expect the Moon to be, square?" Children soon recognize that somehow this kind of question annoys adults. A few more experiences like it, and another child has been lost to science. Why adults should pretend to omniscience before 6-year-olds, I can't for the life of me understand. What's wrong with admitting that we don't know something? Is our self-esteem so tenuous?

What's more, many of these questions go to deep issues in science, some of which are not yet fully resolved. Why the Moon is round has to do with the fact that gravity is a central force

pulling towards the middle of any world, and with how strong rocks are. Grass is green because of chlorophyll, of course, but why do plants have chlorophyll? It seems dumb, since the Sun puts out its peak energy in the yellow and green part of the spectrum. Why should plants all over the world reject sunlight in its most abundant wavelengths? Maybe it's a frozen accident from the ancient history of life on Earth. But there's something we still don't understand about why grass is green.

There are many better responses than making the child feel that asking deep questions constitutes a social blunder. If we have an idea of the answer, we can try to explain. Even an incomplete attempt constitutes an encouragement. If we have no idea of the answer, we can go to the encyclopedia. If we don't have an encyclopedia, we can take the child to the library. Or we might say: "I don't know the answer. Maybe no one knows. Maybe when you grow up, you'll be the first person to find out."

There are naive questions, ^{tedious questions,} ill-phrased questions, questions ^{put after} ~~phrased with~~ inadequate self-criticism. But every question is a ~~human~~ cry to understand the world.* There is no such thing as a dumb question.

Bright, curious children are a national and world resource. They need to be cared for, cherished, and encouraged. But mere encouragement isn't enough. We must also give them the essential

*I'm excluding the fusillade of "whys" that two-year-olds sometimes pelt their parents with -- perhaps in an effort to control adult behavior.

tools to think with.

* * *

"It's Official," reads one newspaper headline: "We Stink in Science." In tests of average 17-year-olds in many world regions, the U.S. ranked dead last in algebra. On identical tests, the U.S. kids averaged 43% and their Japanese counterparts 78%. In my book, 78% is pretty good -- it corresponds to a C+, or maybe even a B-; 43% is an F. In a chemistry test, students in only two of 13 nations did worse than the U.S. Britain, Singapore, and Hong Kong were so high they were almost off-scale, and 25% of Canadian 18-year-olds knew just as much chemistry as a select 1% of American high school seniors (in their second chemistry course, and most of them in "advanced" placement programs). The best of 20 fifth-grade classrooms in Minneapolis was outpaced by every one of 20 classrooms in Sendai, Japan, and 19 out of 20 in Taipei, Taiwan. South Korean students were far ahead of American students in all aspects of mathematics and science, and 13-year-olds in British Columbia (in Western Canada) outpaced their U.S. counterparts across the boards (in some areas they did better than the Koreans). Of the U.S. kids, 22% say they dislike school; only 8% of the Koreans do. Yet two-thirds of the Americans, but only a quarter of the Koreans, say they are "good at mathematics."

...defending 360 other students from 68 ~~countries~~^{nations} in algebra, geometry and number theory. One of them, ^{17-year-old} Jeremy Ben, commented "Math problems are logic puzzles. There's no routine -- it's all very creative and artistic."

["No Such Thing as a Dumb Question" (M, 11/28/94)]

6

Such trends for average students in the United States are occasionally offset by the performance of outstanding students. In 1994, American students ^{at the International} ~~in a~~ mathematics Olympiad ^{al} ~~[check]~~ ^{in Hong Kong} achieved an unprecedented perfect score. But here I'm concerned not with producing a new generation of first-rate scientists and mathematicians, but a scientifically literate public.

Sixty-three percent of American adults are unaware that the last dinosaur died before the first human arose; 75 percent do not know that antibiotics kill bacteria but not viruses. Polls show that something like 20 percent of American adults are ignorant of the fact that the Earth goes around the Sun and takes a year to do it. I can find in my introductory undergraduate classes at Cornell University bright students who do not know that the stars rise and set at night, or even that the Sun is a star.

Because of science fiction, the educational system, NASA, and the role that science plays in society, Americans have much more exposure to the Copernican insight than does the average human. A 1993 poll by the China Association of Science and Technology shows that no more than half the people in China know that the Earth revolves around the Sun once a year. It may very well be, then, that more than four and a half centuries after Copernicus, most people on Earth still think, in their heart of hearts, that our planet sits immobile at the center of the Universe, and that we are profoundly "special."

I meet many people offended by evolution, who passionately prefer to be the personal handicraft of God than to arise by blind physical and chemical forces over aeons from slime. Evidence has little to do with it: What they wish to be true, they believe is true. (They are also less than assiduous in exposing themselves to evidence.) Only nine percent of Americans accept the central finding of modern biology that human beings (and all the other species) have slowly evolved through natural processes from a succession of more ancient precursors with no divine intervention along the way. (When asked merely if they accept evolution, 45 percent of Americans say yes. The figure is 70 percent in China.) The clearest evidence of this evolution can be found in our genes. But evolution is still being fought, ironically by those whose own DNA proclaims it -- in the schools, in the courts, in textbook publishing houses, and on the question of just how much pain we can inflict on other animals without crossing some ethical threshold.

During the Great Depression, teachers enjoyed job security, good salaries, respectability. Teaching was an admired profession, partly because learning was widely recognized as the road out of poverty. Little of that is true today. And so science (and other) teaching is too often incompetently or uninspiringly done, its practitioners, astonishingly, having little or no training in their subjects -- and sometimes themselves unable to distinguish science from pseudoscience.

Those who do have the training often get higher-paying jobs elsewhere.

Children need hands-on experience with the experimental method rather than just reading about it in a book. We can read about oxidation of wax as the explanation of the candle flame. But we have a much more vivid sense of what's going on if the candle burns briefly in a bell jar until all the oxygen in the jar's air is consumed, and the flame flickers and dies. We can be taught about mitochondria in cells, how they mediate the oxidation of food like the flame burning the wax, but it's another thing altogether to see them under the microscope. We may be told that oxygen is necessary for the life of some organisms and not others. But we begin to really understand when we test the proposition in that oxygen-depleted bell jar. What does oxygen do for us? Why do we die without it? Where does the oxygen in the air come from? How secure is the supply?

Experiment, can be taught in many areas other than science, ^{and} using the scientific method. Daniel Kunitz is a friend of mine from college. ^{We played together} (~~He was a guard~~ on a championship intramural basketball team, ^{that I captained} ~~I played center.~~) He's spent his life as an innovative junior and senior high school social sciences teacher. Want the students to understand the Constitution of the United States? You could have them read it, Article by Article, and then discuss it in class -- but, sadly, this will put most of them to sleep. Or you could try the Kunitz method: You forbid

the students to read the Constitution. Instead, you assign them, two for each state, to attend a Constitutional Convention. You brief each of the thirteen teams on the particular interests of their state and region. The South Carolina delegation, say, would be told of the primacy of cotton, the necessity and morality ~~order~~ of the slave trade, the danger posed by the industrial North, and so on. The thirteen delegations assemble, and mainly on their own, over a week or two, with a little faculty guidance, write a constitution. Then they read the real Constitution. The students have reserved war-making powers to the President; the delegates of 1787 assigned them to Congress. Why? The students have freed the slaves. The original Constitutional Convention did not. Why? This takes more preparation by the teachers and more work by the students, but the experience is unforgettable. It's hard not to think ~~we'd~~ ^{that the United States would} be in better shape if every citizen ^{a comparable} went through ~~this~~ experience.

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We need more money for teachers' training and salaries, and for laboratories. But all across America, school-bond issues ~~on~~ ^{voted down.} ~~the ballot~~ are regularly defeated. No one suggests that property taxes be used to provide for the military budget, or for agriculture, or for cleaning up toxic wastes. Why just education? Why not support it from general taxes on the local and state levels? What about a special education tax for those industries with special needs for technically trained workers?

American schoolchildren don't do enough schoolwork. There are 180 days in the standard school year in the United States, as compared to 220 in South Korea, about 230 in Germany, and 243 in Japan. Children in some of these countries go to school on Saturday. The average American high school student spends 3.5 hours a week on homework. The total time devoted to studies, in and out of the classroom, is about 20 hours a week. Japanese fifth-graders average 33 hours a week. Japan, with half the population of the United States, produces twice as many scientists and engineers with advanced degrees every year.

During four years of high school, American students spend less than 1,500 hours on such subjects as mathematics, science, and history. Japanese, French, and German students spend more than twice as much time. A 1994 report commissioned by the U.S. Department of Education notes:

The traditional school day must now fit in a whole set of requirements for what has been called the "new work of the schools" -- education about personal safety, consumer affairs, AIDS, conservation and energy, family life and driver's training.

So, because of the deficiencies of the society and the inadequacies of education in the home, only about three hours a day are spent in high school on the core academic subjects.

Academic success is now ^{no more than} barely defined ^{by} ~~in terms of~~ what the students know.

There's a widely held perception that science is "too hard" for ordinary people. We can see this reflected in the statistic

that only around 10 percent of American high school students ever opt for a course in physics. What makes science suddenly "too hard"? Why isn't it too hard for the citizens of all those other countries that are outperforming the United States? What has happened to the American genius for science, technical innovation, and hard work? Where did all that "Yankee ingenuity" go?

Most American children aren't stupid. Part of the reason they don't study hard is that they receive few tangible benefits when they do. Competency (that is, actually knowing the stuff) in verbal skills, mathematics, science, and history these days doesn't increase earnings for average young men in their first eight years out of high school -- many of whom take service rather than industrial jobs.

In the productive sectors of the economy, though, the story is different. There are furniture factories, for example, in danger of going out of business -- not because there are no customers, but because so few entry-level workers can do simple arithmetic. A major electronics company reports that 80% of its job applicants can't pass a fifth-grade mathematics test. The United States already is losing some \$~~7~~⁸0 billion a year (mainly in lost productivity and the cost of remedial education) because workers, to too great a degree, can't read, write, count, or think.

In a survey by the National Science Board of 139 high technology companies in the United States, the chief causes of the research and development decline attributable to U.S. policy were (1) lack of a long-term strategy for dealing with the problem; (2) too little attention to the training of future scientists and engineers; (3) too much investment in defense, and too little in civilian research and development; and (4) too little attention to pre-college education. Ignorance feeds on ignorance. Science phobia is contagious.

Those in America with the most favorable view of science tend to be young, well-to-do, college-educated white males. But three-quarters of new American workers in the next decade will be women, nonwhites, and immigrants. Discriminating against them isn't only unjust, it's also self-defeating. It deprives the economy of desperately needed skilled workers.

African-American and Hispanic students are doing significantly better in standardized science tests now than in the late 1960s, but they're the only ones who are. The average math gap between white and black U.S. high school graduates is still huge -- two to three grade levels; but the gap between white U.S. high school graduates and those in, say, Japan, Canada, Great Britain, or Finland is more than twice as large. If you're poorly motivated and poorly educated, you won't know much -- no mystery there. Suburban African-Americans with college-educated parents do just as well in college as suburban

whites with college-educated parents. According to some statistics, enrolling a poor child in a Head Start program doubles his or her chances to be employed later in life; one who completes an Upward Bound program is four times as likely to get a college education. If we're serious, we know what to do.

What about college and university? There are obvious steps to take: higher status for teaching faculty, and promotions based on the performance of their students; salaries for teachers that approach what they could get in industry; more scholarships, fellowships, and laboratory equipment; imaginative, inspiring curricula and textbooks; laboratory courses required of everyone to graduate; and special attention paid to those traditionally steered away from science. We should also encourage academic scientists to spend more time on public education -- lectures, newspaper and magazine articles, TV appearances. And a mandatory freshman or sophomore course in skeptical thinking and the methods of science might be worth trying.

* * *

The mystic William Blake stared at the Sun and saw angels there, while others, more worldly, "perceived only an object of about the size and colour of a golden guinea." Did Blake really see angels in the Sun, or was it some perceptual or cognitive error? I know of no photograph of the Sun that shows anything of

the sort. Did Blake see what the photograph and the telescope cannot? Or does the explanation lie much more inside Blake's head than outside? And is not the truth of the Sun's nature as revealed by modern science far more wonderful: ^{no mere gold coin, but} an enormous sphere into which a million ~~{check}~~ Earths could be packed, in the core of which the hidden nuclei of atoms are being jammed together, hydrogen transfigured into helium, the energy latent in hydrogen for billions of years released, and the Earth and other planets warmed and lit thereby?

The blueprints, detailed instructions, and job orders for building you from scratch would fill about 1,000 encyclopedia volumes if written out in English. Yet each cell in your body has a set of these encyclopedias. A quasar is so far away that the light we see from it began its intergalactic voyage before the Earth was formed. Every person on Earth is descended from the same not-quite-human ancestors in East Africa around 2 million years ago, making us all cousins.

When I think about any of these discoveries, I feel a tingle of exhilaration. My heart races. I can't help it. Science is an astonishment and a joy. Every time a spacecraft flies by a new world, I find myself amazed. Planetary scientists ask themselves: "Oh, is that the way it is? Why didn't we think of that?" But nature is always more subtle, more intricate, more elegant than what we are able to imagine. Given our manifest human limitations, what is surprising is that we have been able

to penetrate so far into the secrets of Nature.

Nearly every scientist has experienced, in a moment of discovery or sudden understanding, something akin to reverence and awe. Science -- pure science, science not for any practical application but for its own sake -- is a deeply emotional matter for those who practice it, as well as for those nonscientists who every now and then dip in to see what's been discovered lately.

And, as in a detective story, it's fun to frame the key questions, to work through the alternative explanations, to advance the investigation:

- Yes, the new preservative causes cancer in rats. But do you have to give a person, who weighs much more than a rat, a pound a day of the stuff to induce cancer? Maybe the new preservative isn't all that dangerous. Might the benefit of having food preserved for long periods outweigh the small additional risk of cancer? Who decides? What data do they need to make a prudent decision?

- In a 3.8 billion-year-old rock, you find a ratio of carbon isotopes typical of living things today. Do you deduce abundant life on Earth 3.8 billion years ago? Or could the chemical remains of more modern organisms have infiltrated into the rock?

- Your theory of the origin of the Solar System predicts many flat disks of gas and dust all over the Milky Way. You look through the telescope and you find flat disks everywhere. Joyfully, you conclude that your theory is confirmed. But it

turns out the disks you ^{sighted} cited were spiral galaxies far beyond the Milky Way, much too big to be nascent solar systems. Should you abandon your theory? Or should you look for a different category of gas and dust disk? Or is this just an expression of your unwillingness to abandon a discredited hypothesis?

- Petit mal epilepsy has plagued your childhood. Your mother has taken you to every doctor in sight and tried all sorts of quack cures. One day she meets a mutual friend who tells about a miraculous herbalist. You are taken to her apartment. She mixes a stinking brew, tells you to take two teaspoonfuls five times a day, and predicts that your symptoms will get worse for a few days; then you'll be cured forever. This is exactly what happens. Bearing in mind that the symptoms of petit mal epilepsy often disappear spontaneously in early adolescence, did the concoction work a cure?

- You mix violet, blue, green, yellow, orange, and red paints and make a murky brown. Then you mix light of the same colors and you get white. What's going on?

- In the genes of humans and many other animals there are long, repetitive sequences of information (called "nonsense"). Some of these sequences cause genetic diseases. Could it be that segments of the DNA are rogue nucleic acids, reproducing on their own, in business for themselves, disdaining the well-being of the organism they inhabit?

- Many animals behave strangely just before an earthquake. How do they know when seismologists don't?

~~• When~~ The oldest stars seem to be, at the time I'm writing, this older than the Universe. Like the claim that an acquaintance has children older than she is, you don't have to know very much to recognize that someone has made a mistake. Who?

["No Such Thing as a Dumb Question" (M, 11/28/94)]

17

• The ancient Aztec and the ancient Greek words for God are the same. Is this evidence of some contact or commonality of the two civilizations, or should we expect occasional such coincidences between two wholly unrelated languages merely by chance? Or could, as Plato thought, certain words be built into us from birth?

• The human body uses concentrated hydrochloric acid in the stomach to dissolve food and aid digestion. Why doesn't the hydrochloric acid dissolve the stomach?

• Why is ordinary ice white, but pure glacial ice blue?

• Life has been found miles below the surface of the Earth. How deep does it go?

• The Dogon people in the Republic of Mali are said by a French anthropologist to have a legend that the star Sirius has an extremely dense companion star. Sirius in fact does have such a companion, although it requires fairly sophisticated astronomy to detect it. So (1) did the Dogon people descend from a forgotten civilization that had large optical telescopes and theoretical astrophysics? Or, (2) were they instructed by extraterrestrials? Or, (3) did the Dogon hear about the white dwarf companion of Sirius from a visiting European? Or, (4) was the French anthropologist mistaken and the Dogon in fact never had such a legend?

* * *

Why should it be hard for scientists to get science across? Some scientists -- including some very good ones -- tell me they'd love to popularize, but feel they lack talent in this area. Knowing and explaining, they say, are not the same thing. What ^{'s} ~~is~~ the secret?

There's only one, I think: Don't talk to the general audience as you would to your scientific colleagues. There are terms that convey your meaning instantly and accurately to fellow experts. You may parse these phrases every day in your professional work. But they do no more than mystify an audience of nonspecialists. Use the simplest possible language. Above all, remember how it was before you yourself understood whatever it is you're explaining. Remember the misunderstandings that you almost fell into, and note them explicitly. Keep firmly in mind that there was a time when you didn't understand any of this at all. Never forget that native intelligence is widely distributed in our species. Indeed, it is the secret of our success.

The effort involved is slight, the benefits great. Among the potential pitfalls are oversimplification, the need to be sparing with qualifications (and quantifications), inadequate credit given to the many scientists involved, and insufficient distinctions drawn between helpful analogy and reality. Doubtless, compromises must be made.

The more you make such presentations, the clearer it is which approaches work and which do not. There is a natural selection of metaphors, images, analogies, anecdotes. After a while you find that you can get almost anywhere you want to go, walking on consumer-tested steppingstones. You can then fine-tune your presentations for the needs of a given audience.

Like some editors and television producers, some scientists believe the public is too ignorant to understand science, that the enterprise of popularization is fundamentally a lost cause. Among the many criticisms that could be made of this judgment is that it is self-confirming.

Most scientists, I think, are comfortable with the idea of popularizing science. (Since nearly all support for science comes from the public coffers, it would be self-defeating, an odd flirtation with suicide, for scientists to oppose competent popularization.) What the public understands and appreciates, it is more likely to support. I don't mean writing articles for Scientific American, say, that are read by science enthusiasts and scientists in other fields. I'm not just talking about teaching introductory courses for undergraduates. I'm talking about efforts to communicate the substance and approach of science in newspapers, magazines, on radio and television, in lectures for the general public, and in elementary, middle, and high school textbooks.

Of course there are judgment calls to be made in popularizing. It's important neither to mystify nor to patronize. In attempting to prod public interest, scientists have on occasion gone too far -- for example, in drawing unjustified religious conclusions. Astronomer George Smoot described his discovery of small irregularities in the radio radiation left over from the Big Bang as "seeing God face-to-face." Physics Nobel Laureate Leon Lederman described the Higgs boson, a hypothetical building block of matter, as "the God particle," and so titled a book. (In my opinion, they're all equally God particles.) If the Higgs boson does not exist, is the God hypothesis disproved? Frank Tipler proposes that future generations of computers will prove the existence of God and work our bodily resurrection. Some religious people feel they are being pandered to by such extravagant metaphors. Others appreciate that science is noticing them at all, and long to have their particular beliefs vindicated by science. To me there's something unwholesome about attempting to support science by suggesting casually, wryly, or in metaphor that its findings buttress mysticism and the supernatural.

Periodicals and television can strike sparks as they give us a glimpse of science, but -- apart from apprenticeship or well-structured seminars -- the best way to popularize science is through textbooks, popular books, CD-ROMs, and laser disks. You can mull things over, go at your own pace, revisit the hard

parts, compare texts, dig deep. But it has to be done right, and in the schools especially it generally isn't. There, as the Australian philosopher John Passmore comments in Science and Its Critics, science is often presented

as a matter of learning principles and applying them by routine procedures. It is learned from textbooks, not by reading the works of great scientists or even the day-to-day contributions to the scientific literature. . . . The beginning scientist, unlike the beginning humanist, does not have an immediate contact with genius. Indeed. . . school courses can attract quite the wrong sort of person into science -- unimaginative boys and girls who like routine.

I hold that popularization of science ^{can be} ~~is~~ successful if, at first, it merely sparks the sense of wonder. To do that, it is often sufficient to provide a glimpse of the findings of science without thoroughly explaining how those findings were achieved. Plainly, it is easier to portray the destination than the journey. But, where possible, popularizers should try to chronicle some of the mistakes, false starts, dead ends, and hopeless confusion along the way. At least every now and then, we should provide the evidence and let the reader draw his or her own conclusion. This converts obedient assimilation of new knowledge into personal discovery. When you make the discovery yourself -- even if you were the last person on Earth to see the light -- you never forget it.

As a youngster, I was inspired by the popular science books and articles of George Gamow, James Jeans, Arthur Eddington, J. B. S. Haldane, Julian Huxley, Rachel Carson, and Arthur C. Clarke -- all of them trained in, and most of them leading practitioners

of science. The popularity of well-written, well-explained, deeply imaginative books on science that touch our hearts as well as our minds seems greater in the last twenty years than ever before, and the number and disciplinary diversity of scientists writing these books is likewise unprecedented. Among the best contemporary scientist-popularizers, I think of Stephen Jay Gould, E. O. Wilson, and Richard Dawkins in biology; Steven Weinberg, Alan Lightman, and Kip Thorne in physics; Roald Hoffmann in chemistry; and the early works of Fred Hoyle in astronomy. Isaac Asimov wrote capably on everything. (And while requiring some calculus, the most consistently exciting, provocative, and inspiring science popularization of the last few decades seems to me to be Volume I of Richard Feynman's Introductory Lectures on Physics.) Nevertheless, current efforts at science popularization are clearly nowhere near commensurate with the public good. And, of course, if we can't read, we can't benefit from such works, no matter how good they are.

Science, I maintain, is an absolutely essential tool for any society with a hope of surviving well into the next century with its fundamental values intact -- not just science as engaged in by its practitioners, but science understood and embraced by the entire human community. If the scientists will not bring this about, who will?

I want us to rescue Mr. "Buckley" and the millions like him. I also want us to stop turning out leaden, incurious, uncritical,

and unimaginative high school seniors. Our species needs, and deserves, a citizenry with minds wide awake and a basic understanding of how the world works.

Chapter 17

HOUSE ON FIRE

The Lord [Buddha] replied to the Venerable Sariputra:

"In some village, city, market town, country district, province, kingdom, or capital there lived a householder, old, advanced in years, decrepit, weak in health and strength, but rich, wealthy, and well-to-do. His house was a large one, both extensive and high, and it was old, having been built a long time ago. It was inhabited by many living beings, some two, three, four, or five hundred. It had one single door only. It was thatched with straw, its terraces had fallen down, its foundations were rotten, its walls, matting-screens, and plaster were in an advanced state of decay. Suddenly a great blaze of fire broke out, and the house started burning on all sides. And that man had many young sons, five, or ten, or twenty, and he himself got out of the house.

"When that man saw his own house ablaze all around with that great mass of fire, he became afraid and trembled, his mind became agitated, and he thought to himself: 'I, it is true, have been competent enough to run out of the door, and to escape from my burning house, quickly and safely, without being touched or scorched by that great mass of fire. But what about my sons, my young boys, my little sons? There, in this burning house, they play, sport, and amuse themselves with all sorts of games. They do not know that this dwelling is afire, they do not understand it, do not perceive it, pay no attention to it, and so they feel no agitation. Though threatened by this great [fire], though in such close contact with so much ill, they pay no attention to their danger, and make no efforts to get out.'"

-- from The Saddharmapundarika, in Buddhist Scriptures, Edward Conze, ed. (Harmondsworth, Middlesex, England: Penguin Books, 1959)

One of the reasons it's so interesting to write for Parade magazine is feedback. With eighty million readers you can really sample the opinion of the citizens of the United States. You can understand how people think, what their anxieties and hopes are, and even perhaps where we have lost our way.

An abbreviated version of the preceding chapter, emphasizing the performance of students and teachers, was published in Parade. I was flooded with mail. Some people denied there was a problem; others said that Americans were losing cutting-edge intelligence and know-how. Some thought there were easy solutions; others, that the problems were too deeply ingrained to fix. Many opinions were a surprise to me.

A 10th-grade teacher in Minnesota handed out copies of the article and asked his students to write and tell me what they thought. Here's what some American high school students wrote (spelling, grammar, and punctuation as in the original letters):

- Not a Americans are stupid We just rank lower in school big deal.
- Maybe that's good that we are not as smart as the other countries. So then we can just import all of our products and then we don't have to spend all of our money on the parts for the goods.
- And if other countries are doing better, what does it matter, their most likely going to come over the U.S. anyway?
- Our society is doing just fine with what discoveries we are making. It's going slowly, but the cure for cancer is coming right along.
- The U.S. has its own learning system and it may not be as advanced as theirs, but it is just as good. Otherwise I think your article is a very educating one.

- Not one kid in this school likes science. I really didn't understand the point of the article. I thought that it was very boring. I'm just not into anything like that.

- I am studying to be a lawyer and frankly I do agree with my parents when they say I have an attitude problem toward science.

- It's true that some American kids don't try, but we could be smarter than any other country if we wanted to.

- Instead of homework, kids will watch TV. I have to agree that I do it. I have cut it down from about 4 hrs. a day.

- I don't believe it is the school systems fault, I think the whole country is brought up with not enough emphasis on school. I know my mom would rather be watching me play basketball or soccer, instead of helping me with an assignment. Most of the kids I know could care less about making sure there doing there work right.

- I don't think American kids are stupid. It just they don't study hard enough because most of kids work. . . Lots of people said that Asian people are smarter than American and they are good at everything, but that's not true. They are not good at sports. They don't have time to play sports.

- I'm in sports myself, and I feel that the other kids on my team push to you to excel more in that sport than in school.

- If we want to rank first, we could go to school all day and not have any social life.

- I can see why alot of science teachers would get mad at you for insulting there job.

- Maybe if the teachers could be more exciting, the children will want to learn. . . If science is made to be fun, kids will want to learn. To accomplish this, it needs to be started early on, not just taught as facts and figures.

- I really find it hard to believe those facts about the U.S. in science.

- If we are so far behind, how come Michael Gorbachev came to Minnesota and Montana to Control Data to see how we run are computers and thing?

- Around 33 hours for fifth graders! In my opinion thats too much thats almost as many hours as a full job practically. So instead of homework we can be making money.

- When you put down how far behind we are in science and math, why don't you try tell us this in a little nicer manner?. . . Have a little pride in your country and its capabilities.

- I think your facts were inconclusive and the evidence very flimsy. All in all, you raised a good point.

* * *

All in all, these students don't think there's much of a problem; and if there is, not much can be done about it. Most

adults who wrote thought there's a substantial problem. I received letters from parents about inquisitive children willing to work hard, passionate about science but with no adequate community or school resources to satisfy ^{their} ~~those~~ interests. Other letters told of parents who knew nothing about science sacrificing their own comfort so their children could have science books, microscopes, telescopes, computers, or chemistry sets; of parents teaching their children that hard work will get them out of poverty; of a grandmother bringing tea to a student up late at night still doing homework; of peer pressure not to do well in school because "it makes the other kids look bad."

Here's a sampling -- not an opinion poll, but representative commentary -- of other responses by parents:

- Do parents understand that you can't be a full human being if you're ignorant? Are there books at home? How about a magnifying glass? Encyclopedia? Do they encourage children to learn?

- Parents have to teach patience and perseverance. The most important gift they can give their children is the ethos of hard work, but they can't just talk about it. The kids who learn to work hard are the ones who see their parents work hard and never give up.

- My child is fascinated by science, but she doesn't get any in school or on TV.

- My child is identified as gifted, but the school has no program for science enrichment. The guidance counselor told me to send her to a private school, but we can't afford a private school.

- There's enormous peer pressure; shy children don't want to "stand out" by doing well in science. When my daughter reached 13 and 14, her life-long interest in science seemed to disappear.

* * *

Parents also had much to say about teachers, and some of the comments by teachers echoed the parents. For example, people complained that teachers are trained how to teach but not what to teach; that a large number of physics and chemistry teachers have no degree in physics or chemistry and are "uncomfortable and incompetent" in teaching science; that teachers themselves have too much science and math anxiety; that they resist being asked questions, or they answer, "It's in the book. Look it up." Some complained that the biology teacher was a "Creationist"; some complained that he wasn't. Among other comments by or about teachers:

- We are breeding a collection of half-wits.
- It's easier to memorize than to think. Kids have to be taught to think.

- The teachers and curricula are "dumbing down" to the lowest common denominator.

- Why is the basketball coach teaching chemistry?

- Teachers are required to spend much too much time on discipline and on "social curricula." There's no incentive to use our own judgment. The "brass" are always looking over our shoulders.

- Abandon tenure in schools and colleges. Get rid of the deadwood. Leave hiring and firing to principals, deans, and superintendents.

- My joy in teaching was repeatedly thwarted by militaristic-type principals.

- Teachers should be rewarded on the basis of performance -- especially student performance on standardized, nationwide tests, and improvements in student performance on such tests from one year to the next.

- Teachers are stifling our children's minds by telling them they're not "smart" enough -- for example, for a career in physics. Why not give the students a chance to take the course?

- My son was promoted even though he's reading two grade levels behind the rest of his class. The reason given was social, not educational. He'll never catch up unless he's left back.

- Science should be required in all school (and especially high school) curricula. It should be carefully coordinated with

the math courses the students are taking at the same time.

- Most homework is "busy work" rather than something that makes you think.

- I think Diane Ravitch [New Republic, March 6, 1989] tells it like it is: "As a female student at Hunter High School in New York City recently explained, 'I make straight As, but I never talk about it. . . It's cool to do really badly. If you are interested in school and you show it, you're a nerd'. . . The popular culture -- through television, movies, magazines, and videos -- incessantly drums in the message to young women that it is better to be popular, sexy, and 'cool' than to be intelligent, accomplished, and outspoken. . . In 1986 researchers found a similar anti-academic ethos among both high school and female students in Washington, D.C. They noted that able students faced strong peer pressure not to succeed in school. If they did well in their studies, they might be accused of 'acting white.'"

- Schools could easily give much more recognition and rewards to kids who are outstanding in science and math. Why don't they? Why not special jackets with school letters? Announcements in assembly and the school newspaper and the local press? Local industry and social organizations to give special awards? This costs very little and could overcome peer pressure not to excel.

- Headstart is the single most effective. . . program for improving children's understanding of science and everything

else.

* * *

There were also many passionate, highly controversial opinions expressed which, at the very least, give a sense of how deeply people feel about the subject. Here's a smattering:

- All the smart kids are looking for the fast buck these days, so they become lawyers, not scientists.
- I don't want you to improve education. Then there'd be nobody to drive the cabs.
- The problem in science education is that God isn't sufficiently honored.
- The fundamentalist teaching that science is "humanism" and is to be mistrusted is the reason nobody understands science. Religions are afraid of the skeptical thinking at the heart of science. Students are brainwashed not to accept scientific thinking long before they get to college.
- Science has discredited itself. It works for politicians. It makes weapons, it lies about marijuana "hazards," it ignores about the dangers of agent orange, etc.
- The public schools don't work. Abandon them. Let's have private schools only.
- We have let the advocates of permissiveness, fuzzy thinking, and rampant socialism destroy what was once a great

educational system.

- The school system has enough money. The problem is that the white males, usually coaches, who run the schools would never (and I mean never) hire an intellectual. . . They care more about the football team than the curriculum and hire only submediocre, flag-waving, God-loving automatons to teach. What kind of students can emerge from schools that oppress, punish, and neglect logical thinking?

[National Education Association]

[American Civil Liberties Union]

- Release schools from the stranglehold of the ACLU, NEA, and others engaged in the breakdown of the discipline and competence in the schools.

- I'm afraid you have no understanding of the country in which you live. The people are incredibly ignorant and fearful. They will not tolerate listening to any [new] idea. . . Don't you get it? The system survives only because it has an ignorant God-fearing population. There's a reason lots of [educated people] are unemployed.

- I'm sometimes required to explain technological issues to Congressional staffers. Believe me, there's a problem in science education in this country.

* * *

There is no single solution to the problem of illiteracy in science -- or math, history, English, geography, and many of the

other skills that our society needs more of. The responsibilities are broadly shared -- parents, the voting public, local school boards, the media, teachers, administrators, ^{federal,} state and local governments, plus, of course, the students themselves. At every level teachers complain that the problem lies in earlier grades. And first-grade teachers can with justice despair of teaching children with learning deficits because of malnutrition, or no books in the home, or a culture of violence in which the leisure to think is unavailable.

I know very well from my own experience ^{how much a child can} ~~the~~ ^{benefits of} ~~from~~ parents who have a little learning, and are able to pass it on. So even small improvements in the education, communication skills, and zest for learning in one generation might work much larger improvements in the next. I think of this every time I hear a complaint that school and collegiate "standards" are falling, ^{or} that a Bachelor's degree doesn't "mean" what it once did.

Dorothy Rich, an innovative teacher from Yonkers, NY, believes that far more important than specific academic subjects is the honing of key skills which she lists as: "confidence, perseverance, caring, teamwork, common sense and problem-solving." To which I'd add skeptical thinking and an aptitude for wonder.

Fixing the crisis in education requires us to distinguish short- from long-term solutions, and to move on many fronts at

once. We will need leadership not just from the top -- a rare enough commodity -- but leadership from the bottom. If science and other education falters, we know what awaits.

[M, 11/28/94]

Chapter 18

THE WIND MAKES DUST

[T]he wind makes dust because it intends to blow, taking away our footprints.

-- Specimens of Bushmen Folklore, W. H. I. Bleek and L. C. Lloyd, collectors, L. C. Lloyd, editor (1911)

[E]very time a savage tracks his game he employs a minuteness of observation, and an accuracy of inductive and deductive reasoning which, applied to other matters, would assure some reputation as a man of science. . . . [T]he intellectual labour of a "good hunter or warrior" considerably exceeds that of an ordinary Englishman.

-- Thomas H. Huxley, Collected Essays, Volume II, Darwiniana: Essays (London: Macmillan, 1907), pp. 175-6 [from "Mr. Darwin's Critics" (1871)]

Why should so many people find science hard to learn and hard to teach? I've tried to suggest some of the reasons -- its precision, its counterintuitive and disquieting aspects, ^{its prospects of misuse,} its independence of authority, and so on. But is there something deeper? Alan Cromer is a physics professor at Northeastern University in Boston who was surprised to find so many students unable to grasp the most elementary concepts in his physics class. In Uncommon Sense: The Heretical Nature of Science (1993), Cromer proposes that science is ~~so~~ difficult because it's ^{is} ~~is~~ so new. We, a species that ^{is} ~~is~~ a few hundred thousand years old, have only had science for a few centuries. We haven't gotten ^{the hang} ~~into the swing~~ of it yet. ~~The fact that it's so new is why it doesn't come easily to us.~~

Except for an unlikely concatenation of historical events, he suggests, we would never have invented science:

This hostility to science, in the face of its obvious triumphs and benefits, is. . . evidence that it is something outside the mainstream of human development, perhaps a fluke.

Chinese civilization invented movable type, gunpowder, the rocket, the magnetic compass, the seismograph, and systematic ~~observations~~ ^{and ~~records~~ chronicles} of the heavens. Indian mathematicians invented the zero, the key to comfortable arithmetic and therefore to quantitative science. Aztec civilization developed a far better calendar than that of the European civilization that inundated and destroyed it; they were better able, and for longer periods into the future, to predict where the planets would be. But none of these civilizations, Cromer argues, had developed the skeptical, inquiring, experimental method of science. All of that came out of ancient Greece:

The development of objective thinking by the Greeks appears to have required a number of specific cultural factors. First was the assembly, where men first learned to persuade one another by means of rational debate. Second was a maritime economy that prevented isolation and parochialism. Third was the existence of a widespread Greek-speaking world around which travelers and scholars could wander. Fourth was the existence of an independent merchant class that could hire its own teachers. Fifth was the Iliad and the Odyssey, literary masterpieces that are themselves the epitome of liberal rational thinking. Sixth was a literary religion not dominated by priests. And seventh was the persistence of these factors for 1,000 years.

That all these factors came together in one great civilization is quite fortuitous; it didn't happen twice.

I'm sympathetic to part of this thesis, and in fact made a similar argument in Cosmos in 1980. The ancient Ionians were the first we know of to argue systematically that laws and forces of Nature, rather than gods, are responsible for the order and even the existence of the world. But those who dismiss the gods tend to be forgotten. The powers that be are not anxious to preserve ^{of such skeptics} ~~their~~ memory, much less their ideas. Culture heroes who try to explain the world in terms of matter and energy may have arisen many times ^{approach} in many cultures, only to be obliterated by the ^{-- as the Ionian ~~wisdom~~ was almost lost after the time of Plato and Aristotle.} priests and philosophers in charge of the conventional wisdom.

With many cultures and many experiments of this sort, it may be that only on rare occasions does the notion take root.

Plants and animals were domesticated and civilization began only ten or twelve thousand years ago. The Ionian experiment is ~~only~~ 2,500 years old. It was almost wiped out entirely. We can see steps towards science in ancient China, India, and elsewhere, even though faltering, incomplete, and bearing little fruit. But suppose the Ionians had never existed, and Greek science and mathematics never flourished. Is it possible that never again in the history of the human species would science have emerged? Or, given many cultures and many alternative historical skeins, isn't it likely that the right combination of factors would come into play somewhere else, sooner or later -- in the islands of Indonesia, say, or in the Caribbean on the outskirts of a Mesoamerican civilization untouched by Conquistadores, or in

Declared

["The Wind Makes Dust" (M, 11/28/94)]

4

Indeed, heresies can be dangerous:

Norse colonies along the Volga and on the shores of the Black Sea, ~~in a world in which Christianity never emerged?~~

The impediments ^{is} to scientific thinking ~~are~~ not, I think, ^{difficulty of the} that the subject ~~is too difficult~~. ^{Complex} Difficult intellectual feats

have been mainstays even of oppressed cultures. Shamans, ^{and theologians} and magicians ^{in their arts} are highly skilled. No, the impediment is political

and hierarchical. In those cultures ~~where there are no~~ ^{lacking}

~~conceptually novel~~ ^{unfamiliar} challenges, external or internal, where ^{is unneeded}, novel ideas ~~need not be encouraged~~

fundamental change ~~occurs extremely slowly~~, where thinking ~~is~~

^{can be safely} rigidified ~~and~~ ^{where and} penalties against impermissible ideas ^{can be safely} are enforced.

~~with some severity, thoughts do not threaten the survival of the~~

~~society~~. But under changing environmental or biological or

political circumstances, simply copying the old ways may no

longer work. ^{Then,} and a premium awaits those who, instead of trying to

foist their preferences onto the Universe, ^{physical or social} are open to what the

Universe teaches. ^{Each society must decide what mix where in}

^{the continuum between openness and rigidity safety lies.}

Greek mathematics was a brilliant step forward. Greek

science, on the other hand -- so often uninformed by experiment

-- was riddled with error. Despite the fact that we cannot see

in pitch darkness, they believed that vision depends on a kind of

radar that emanates from the eye, bounces off what it is we're

seeing, and is returned to the eye. Despite the obvious

resemblance of children to their mothers, they believed that

heredity was carried by semen alone, the woman a mere passive

receptacle. They believed that the horizontal motion of a thrown

rock somehow lifts it up, so that it takes longer to reach the ground than a rock dropped from the same height at the same moment. Enamored of simple geometry, they believed the circle to be "perfect"; despite the "Man in the Moon" and sunspots ~~that are~~ (occasionally visible to the naked eye at sunset), they ~~believed~~ ^{also} the heavens ["] to be perfect; therefore, planetary orbits had to be circular. ~~And the Greeks -- or at least the Platonists among them -- believed that not just a talent for abstract mathematics, but the results of abstract mathematics were somehow already known to the unconscious minds of all of us, even the least~~

~~educated among us.~~ ^{There were some brilliant examples -- Eratosthenes' measurement of the Earth's diameter, say, or Empedocles' experiment on the nature of air. But}

Being freed from superstition isn't enough for science to grow. One must also have the idea of interrogating Nature, of doing experiments. ⁱ In a society in which manual labor is demeaned and thought fit only for slaves, as in the classical Graeco-Roman world, the experimental method does not thrive. Science requires us to be freed of gross superstition and gross injustice both. Often, as in ^{medieval} ~~sixteenth- through eighteenth-~~ century Europe, superstition and injustice are imposed by the same ecclesiastical and secular authorities, working hand in glove. It is no surprise that political revolutions, skepticism about religion, and the rise of science go together. Liberation from superstition is a necessary but not a sufficient condition for science.

At the same time, it is undeniable that central figures in the transition from medieval superstition to modern science were profoundly influenced by the idea of a Supreme God who created the Universe and established not only commandments that humans must live by, but laws that Nature itself must abide by. A central figure in this transition, the seventeenth-century German astronomer Johannes Kepler, described his pursuit of science as a wish to know the mind of God. In our own time, leading figures ⁱⁿ of science, including Albert Einstein and Stephen Hawking, have described their quest in essentially identical terms. The philosopher Alfred North Whitehead and the historian of Chinese ^{technology} ~~culture~~ Joseph Needham have also suggested that what was lacking in the development of science in non-Western cultures was monotheism.

And yet, I think there is strong evidence ~~to the contrary~~ ^{to this whole thesis,} calling out to us from across the millennia. . .

* * *

[Italics:]

The small hunting party follows the trail of hoofprints and other spoor. They pause for a moment by a stand of trees, squatting on their heels and examining the evidence more carefully. The trail they've been following has been crossed by another. Quickly they agree on which animals these are, how many

of them, what ages and sexes, whether any are injured, how fast they're traveling, how long ago they passed, whether any other hunters are in pursuit, whether the party can overtake the game, and if so, how long it will take. The decision made, they flick their hands over the trail they will follow, make a quiet sound between their teeth like the wind, and off they ^{lope.} ~~run~~. Despite their bows and poison arrows, they continue at championship marathon racing form for hours. Almost always they've read the message in the ^{ground} ~~spoor~~ correctly. The wildebeests or elands or okapis are where they thought, in the numbers and condition they estimated. The hunt is successful. Meat is carried back to the temporary camp. ^{Everyone in} ~~All members~~ of the band ^{feasts.} ~~partake~~. [End of italics.]

This more or less typical hunting vignette comes from the !Kung San people of the Kalahari Desert, in the Republics of Botswana and Namibia, who are now, tragically, on the verge of extinction. But for decades they and their way of life were studied by anthropologists. The !Kung San may be typical of the hunter-gatherer mode of existence in which humans spent most of their time -- until ten thousand years ago, when plants and animals were domesticated and the human condition began to change, perhaps forever. They were trackers of such legendary prowess that they were enlisted by the ^{pro-apartheid} South African army to hunt down human prey in the wars against the "front-line states."

This encounter with the white South African military in several different ways accelerated the destruction of the !Kung-San way of life -- that had, in any case, been ^{deteriorating} ~~occurring~~ bit by bit over the centuries from every contact with European civilization.

How do they do it? How could they tell so much from barely more than a glance? Saying they're keen observers explains nothing. What actually do they do? [¶] They scrutinize the shape of the depressions. The footprints of a fast-moving animal ^{display} ~~bear~~ a different symmetry than those of a slower one. An animal a little lame favors the afflicted foot, puts less weight on it, and leaves a fainter imprint. The hunters examine the depth of the footprint. The deeper and broader the hollow left in the scrub desert, the heavier was the animal. The correlation function is in the heads of the hunters.

In the course of the day, the footprints erode a little. The walls of the depression tend to crumble. Windblown sand accumulates on the floor of the hollow. Perhaps bits of leaf, twigs, or grass are blown into it. The longer you wait, the more such erosion there is.

This method is essentially identical to what planetary astronomers ^{use} ~~do~~ in analyzing craters left by impacting worldlets: other things being equal, the shallower the crater, the older. Craters with slumped walls, with modest depth-to-diameter ratios, with fine particles accumulated in their interiors ^{tend to be} ~~are, other~~ ~~things being equal~~, more ancient -- because they had to be around

long enough for these erosive processes to come into play.

The sources of degradation may differ from world to world, or desert to desert, or epoch to epoch. But if you know what they are you can determine a great deal from how crisp or blurred the crater is. If insect or other animal tracks are superposed on the hoofprints, this also argues against their freshness. The subsurface moisture content of the soil and the rate at which it dries out after being exposed by a hoof determine how friable the crater walls are. All these matters are closely studied by the !Kung.

The galloping herd hates the hot Sun. The animals will ~~take~~^{use} advantage of whatever shade they can ~~find~~^{find}. ~~If there is~~^{from} a stand of trees, they will alter course to take brief advantage of the shade. But where the shadow is depends on the time of day, because the Sun is moving across the sky. In the morning, as the Sun is rising in the east, shadows are cast west of the trees. Later in the afternoon, as the Sun is setting toward the west, shadows are cast to the east. From the swerve of the tracks, it's possible to tell how long ago the animals passed. This calculation will be different in different seasons of the year. So the hunters must carry in their heads a kind of astronomical calendar predicting the apparent solar motion.

To me, all of these formidable forensic tracking skills are science in action.

Not only are hunter-gatherers expert in the tracks of other animals; they also know human tracks very well. Every member of the band is recognizable by his or her footprints; they are as familiar as their faces. Laurens van der Post recounts,

[W]hen many miles from home and separated from the rest, Nxou and I, on the track of a wounded buck, suddenly found another set of prints and spoor joining our own. He gave a deep grunt of satisfaction and said it was Bauxhau's footmarks made not many minutes before. He declared Bauxhau was running fast and that we would soon see him and the animal. We topped the dune in front of us and there was Bauxhau, already skinning the animal.

Or Richard Lee, also among the !Kung San, relates how when briefly examining some tracks a hunter commented, "Oh, look, Tunu is here with his brother-in-law. But where is his son?"

Is this really science? Does every tracker in the course of his training sit on his haunches for hours, following the slow degradation of an eland hoofprint? When the anthropologist asks this question, the answer is that hunters have always used such methods. They observed their fathers and other accomplished hunters during their apprenticeships. They learned by imitation. The general principles are passed down from generation to generation. The local variations -- wind speed, soil moisture -- must be updated in each generation, or seasonally, or on a day-by-day basis.

But modern scientists do just the same. Every time we try to judge the age of a crater on the Moon or Mercury or Triton, by its degree of erosion, we do not perform the calculation from scratch. We dust off a certain scientific paper and read off the

tried-and-true numbers that have been set down perhaps ^{as much as} a generation earlier. Physicists do not derive Maxwell's equations or quantum mechanics from scratch. They try to understand the principles and the mathematics, they observe its utility, they note how Nature follows these rules, and they take these sciences to heart, making them their own.

Yet someone had to figure out all these tracking protocols for the first time, perhaps some paleolithic genius, or more likely a succession of geniuses in widely separated times and places. There is no hint in the !Kung tracking practice of magical methods ~~and entreaties~~ -- examining the stars the night before or the entrails of an animal, or casting dice, or interpreting dreams, or conjuring demons, or any of the myriad other spurious claims to knowledge that humans have intermittently entertained. Here there's a specific, well-defined question: Which way did the prey go and what are its characteristics? You need a precise answer that magic and divination simply do not provide -- or at least not often enough to stave off starvation. Instead hunter-gatherers -- who are not very superstitious in their everyday life, except during trance dances around the fire and under the influence of mild euphorants -- are practical, workaday, motivated, social, and often ^{very} cheerful. They employ skills honed from past successes and failures.

The same is true, for instance, of Polynesian seafaring skills

^{Scientific} Such skills have almost certainly been with us from the beginning. You can even see ^{then} it in chimpanzees when tracking on patrol of the frontiers of their territory, or when preparing a reed to insert into the termite mound to extract a modest but much-needed source of protein. The development of tracking skills delivers a powerful evolutionary selective advantage. Those groups unable to figure it out get less protein and leave fewer offspring. Those with a scientific bent, those able to patiently observe, those with a penchant for figuring out acquire ^{, and live in more varied habitats} more food, especially more protein; they and their hereditary lines prosper. ^{Scientific thinking brings tangible rewards.}

The other principal food-garnering activity of pre-agrarian societies is foraging. To forage, you must know the properties of many plants, and you must certainly be able to distinguish one from another. Botanists and anthropologists have repeatedly found that all over the world hunter-gatherer peoples have distinguished the various plant species with at least the precision of Western taxonomists. They have mapped their territory with greater finesse than the cartographers. Again, all this is a precondition for survival.

^{So it's} ~~For these reasons, it is also~~ nonsense to claim that just as children are not developmentally ready for certain concepts in mathematics or logic, so "primitive" peoples are not intellectually able to grasp science and technology. This vestige of colonialism and racism is belied by the everyday

activities of people living with no fixed abode and almost no possessions, the few remaining hunter-gatherers -- custodians of our past and our nature.

Of Cromer's criteria for "objective thinking," we can certainly find in hunter-gatherer peoples vigorous substantive^{and democratic} debate, wide-ranging travel, no priests, and the persistence of these factors not for 1,000 but for 300,000 years or more. By his criteria hunter-gatherers ought to have science. I think they do. Or did.

Likewise, in the history of ancient Greece, we can see nearly all significant events driven by the caprice of the gods in Homer, ^{only} a few, in Herodotus, and essentially none^{at all} in Thucydides. In a few hundred years, history passed from god-driven to human-driven.

What Ionia and ancient Greece in general provided is not so much inventions or technology or engineering, but the idea of systematic inquiry, the notion of laws of Nature that, rather than capricious gods, govern the world. Water, air, earth, and fire all had their turn as candidate "explanations" of the nature and origin of the world. Each such explanation -- identified with a different pre-Socratic philosopher -- was deeply flawed in its details. But the mode of explanation^{circumventing divine intervention,} was productive and new.

Monotheism may indeed have played a powerful role in the scientific outlook of key figures in the development of modern science. You can see the utility of the God hypothesis in formulating laws of Nature from the two current uses of the word "law": fiat by the judicial authorities, and the invariable

course of Nature. A supreme God makes laws simultaneously in the juridical and the scientific realm.

But something akin to laws of Nature ^{was} once ^{glimpsed} arose in a determinedly polytheistic society, in which some scholars toyed with a form of atheism. The approach of the pre-Socratics was, beginning in about the fourth century B.C., quenched by Plato, Aristotle, and then Christian philosophers. If the skein of historical causality had been different -- if the brilliant guesses of the atomists on the nature of matter, the plurality of worlds, the vastness of space and time had been treasured and built upon, if the innovative technology of Archimedes had been taught and emulated, if the notion of invariable laws of Nature that humans must seek out and understand had been widely propagated -- I wonder what kind of world we would live in now.

Even in a culture ridden with superstition, it is rare that people believe the butcher shop, say, to be floating in the air above the church. For the practical matters of life we humans, almost all of us, are sound, reliable, no-nonsense modelers of an external reality. That propensity goes all the way back to our beginnings.

I don't think science is hard to teach because humans aren't ready for it, or because it arose only through a fluke, or because we don't have the brainpower to grapple with it. Instead, the enormous zest for science that I see in first-graders and the lesson from the remnant hunter-gatherers both

speaking eloquently: A proclivity for science is embedded deeply within us. It has been the means for our survival. It is our birthright. When, through indifference, inattention, incompetence, or fear of skepticism, we discourage children from science, we are disenfranchising them, taking from them the tools needed to manage their future, ^{we have then} and hobbling ^{ed} the human prospect.

[M, 11/28/94]

Chapter 19

THE PATH TO FREEDOM*

There is nothing which can better deserve our patronage than the promotion of science and literature. Knowledge is in every country the surest basis of public happiness.

-- George Washington, address to Congress, January 8,
1790

Frederick Bailey was a slave. As a boy in Maryland in the 1820s, he had no mother or father to look after him. ("It is a common custom," he later wrote, "to part children from their mothers. . . before the child has reached its twelfth month.") He was one of countless millions of slave children whose realistic prospects for a hopeful life were nil.

What Bailey witnessed and experienced in his growing up marked him forever: "I have often been awakened at the dawn of day by the most heart-rending shrieks of an own aunt of mine, whom [the overseer] used to tie up to a joist, and whip upon her naked back till she was literally covered with blood. . . From the rising till the going down of the sun he was cursing, raving, cutting, and slashing among the slaves of the field. . . He seemed to take pleasure in manifesting his fiendish barbarity."

The slaves had drummed into them, from plantation and pulpit alike, from courthouse and statehouse, the notion that they were

*Written with Ann Druyan.

hereditary inferiors, that God intended them for their misery. In these ways the institution of slavery maintained itself despite its monstrous nature -- something even its practitioners must have glimpsed.

There was a most revealing rule: Slaves were to remain illiterate. In the antebellum South, whites who taught a slave to read were severely punished. "[To] make a contented slave," Bailey later wrote, "it is necessary to make a thoughtless one. It is necessary to darken his moral and mental vision, and, as far as possible, to annihilate the power of reason." This is why the slaveholders must control what slaves hear and see and think. This is why reading and critical thinking are dangerous, indeed subversive, in an unjust society.

So now picture Frederick Bailey in 1828 -- a 10-year-old African-American child, enslaved, with no legal rights of any kind, torn from his mother's arms, sold away from the tattered remnants of his extended family as if he were a calf or an anvil, conveyed to an unknown household in the strange city of Baltimore, condemned to a life of drudgery with no prospect of reprieve.

Bailey was sent to work for Capt. Hugh Auld and his wife, Sophia, moving from plantation to urban bustle, from field work to housework. In this new environment, he came every day upon letters, books, and people who could read. He discovered what he called "this mystery" of reading: There was a connection between

the letters on the page and the movement of the reader's lips, a nearly one-to-one correlation between the black squiggles and the sounds uttered. Surreptitiously, he studied from young Tommy Auld's Webster's Spelling Book. He memorized the letters of the alphabet. He tried to understand the sounds they stood for. Eventually, he asked Sophia Auld to help him learn. Impressed with the intelligence and dedication of the young boy, and perhaps ignorant of the prohibitions, she complied.

By the time Frederick was spelling words of three and four letters, Captain Auld discovered what was going on. Furious, he ordered Sophia to stop. In Frederick's presence he explained:

A nigger should know nothing but to obey his master -- to do as he is told to do. Learning would spoil the best nigger in the world. Now, if you teach that nigger how to read, there would be no keeping him. It would forever unfit him to be a slave.

Auld chastised Sophia in this way as if Frederick Bailey were not there in the room with them, or as if he were a block of wood.

But Auld had revealed to Bailey the great secret: "I now understood. . . the white man's power to enslave the black man. From that moment, I understood the pathway from slavery to freedom."

Without further help from the now reticent and intimidated Sophia Auld, Frederick found ways to continue learning how to read, including buttonholing white schoolchildren on the streets. Then he began teaching his fellow slaves: "Their minds had been starved. . . They had been shut up in mental darkness. I taught

them, because it was the delight of my soul."

With his knowledge of reading playing a key role in his escape, Bailey fled to New England, where slavery was illegal and black people were free. He changed his name to Frederick Douglass (after a character in Walter Scott's The Lady of the Lake), eluded the bounty hunters hunting escaped slaves, and became one of the great orators, writers, and political leaders in American history. All his life, he understood that literacy had been the way out.

* * *

For 99 percent of the tenure of humans on earth, nobody could read or write. The great invention had not yet been made. Except for firsthand experience, almost everything we knew was passed on by word of mouth. As in the children's game "Telephone," over tens and hundreds of generations, information would slowly be distorted and lost. As time went on, we knew less and less about our own origins and history and nature.

Books changed all that. Books, purchasable at low cost, permit us to interrogate the past with high accuracy; to tap the wisdom of our species; to understand the point of view of others, and not just those in power; to contemplate -- with the best teachers -- the insights, painfully extracted from Nature, of the greatest minds that ever were, drawn from the entire planet and

from all of our history. They allow people long dead to talk inside our heads. Books can accompany us everywhere. Books are patient where we are slow to understand, allow us to go over the hard parts as many times as we wish, and are never critical of our lapses. Books are key to understanding the world and participating in a democratic society.

Nevertheless, a national survey done for the U.S. Department of Education paints a picture of a country with more than 40 million illiterate or barely literate adults. Other estimates are much higher. The literacy of young adults has slipped dramatically in the last decade. Only 3 to 4 percent of the population scores at the highest of five reading levels (essentially everybody in this group has gone to college). The vast majority have no idea how bad their reading is.

Only 4 percent of those at the highest reading level are in poverty, but 43 percent of those at the lowest reading level are. Although it's not the only factor, of course, in general the better you read, the more you make -- an average of about \$12,000 a year at the lowest reading level, and about \$34,000 a year at the highest reading level. And you're much more likely to be in prison if you're illiterate or barely literate.

If Frederick Douglass as an enslaved child could teach himself into literacy and greatness, why should anyone in our more enlightened day and age remain unable to read? Well, it's not that simple -- in part because few of us are as brilliant and

courageous as Frederick Douglass, but for other important reasons as well:

If you grow up in a household where there are books, where you are read to, where parents, siblings, aunts, uncles, and cousins read for their own pleasure, naturally you learn to read. If no one close to you takes joy in reading, where is the evidence that it's worth the effort? If the quality of education available to you is inadequate, if you're taught rote memorization rather than how to think, if the content of what you're first given to read comes from a nearly alien culture, literacy can be a rocky road.

You have to internalize, so they're second nature, dozens of upper- and lower-case letters, symbols, and punctuation marks; memorize thousands of dumb spellings on a word-by-word basis; and conform to a range of rigid and arbitrary rules of grammar. If you're preoccupied by the absence of basic family support or dropped into a roiling sea of anger, neglect, exploitation, and self-hatred, you might well conclude that reading takes too much work and just isn't worth the trouble. If you're repeatedly given the message that you're too stupid to learn (or, the functional equivalent, too cool to learn), and if there's no one there to contradict it, you might very well buy this advice. There are always some children -- like Frederick Bailey -- who beat the odds. Too many don't.

But, beyond all this, there's a particularly insidious way in which, if you're poor, you may have another strike against you in your effort to read -- and even to think.

Ann Druyan and I come from families that knew grinding poverty. But our parents were passionate readers. One of our grandmothers learned to read because her father, a subsistence farmer, traded a sack of onions to an itinerant teacher. She read for the next hundred years. Our parents followed prescriptions on childhood nutrition recommended by the U.S. Department of Agriculture as if they had been handed down from Mount Sinai. For a while, my parents gave up smoking -- one of the few pleasures available to them in the Depression years -- so their infant could have vitamin and mineral supplements. We were very lucky.

Recent research shows that many children without enough to eat wind up with diminished capacity to understand and learn ("cognitive impairment"). Children don't have to be starving for this to happen. Even mild undernourishment -- the kind most common among poor people in America -- can do it. This can happen before the baby is born (if the mother isn't eating enough), in infancy, or in childhood. When there isn't enough food, the body has to decide how to invest the limited foodstuffs available. Survival comes first. Growth comes second. In this nutritional triage, the body seems obliged to rank learning last. Better to be stupid and alive than smart and dead.

Instead of showing an enthusiasm, a zest for learning -- as most healthy youngsters do -- the undernourished child becomes bored, apathetic, unresponsive. More severe malnutrition leads to lower birth weights and, in its most extreme forms, smaller brains. However, even a child who looks perfectly healthy but has not enough iron, say, suffers an immediate decline in the ability to concentrate. Iron-deficiency anemia may affect as much as a quarter of all low-income children in America; it attacks the child's attention span and memory, and may have consequences reaching well into adulthood.

What once was considered relatively mild undernutrition is now understood to be potentially associated with lifelong cognitive impairment. Children who are undernourished even on a short-term basis have a diminished capacity to learn. And millions of American children go hungry every week. Lead poisoning, which is endemic in inner cities, also causes serious learning deficits. ^{By many criteria,} The prevalence of poverty in America has been steadily increasing since the early 1980s ~~{check}~~. Almost a quarter of American children now live in poverty -- the highest rate of childhood poverty in the industrialized world.

Some programs wisely instituted on the Federal or state level in America deal with malnutrition. The Special Supplemental Food Program for Women, Infants, and Children (WIC), the school breakfast and lunch programs, the Summer Food Service Program -- all have been shown to work, although they do not get

But there are many schools in America in which reading is taught as ~~if~~ a tedious and reluctant excursion into the hieroglyphics of an unknown civilization, and many classrooms in which not a single book can be found.

to all the people who need them. So rich a country is well able to provide enough food for all its children.

Some deleterious effects of undernutrition can be undone; iron-repletion therapy, for example, can repair some consequences of iron-deficiency anemia. But not all of the damage is reversible. Dyslexia -- various disorders that impair reading skills -- may affect 15 percent of us or more, rich and poor alike. Its causes (whether biological, psychological, or environmental) are often undetermined. But methods now exist to help many with dyslexia to learn to read.

No one should be unable to learn to read because education is unavailable. ~~But~~ Sadly, the demand for adult literacy classes far outweighs the supply. High-quality early education programs such as Head Start can be enormously successful in preparing children for reading. But Head Start reaches only about a third of eligible preschoolers, and it and the nutrition programs I mentioned are under renewed Congressional attack as I write.

The National Center for Family Literacy, based in Louisville, KY, has been implementing programs aimed at low-income families to teach both children and their parents to read. It works like this: The child, 3 to 4 years old, attends school three days a week along with a parent, or possibly a grandparent or guardian. While the grown-up spends the morning learning basic academic skills, the child is in a preschool class. Parent

and child meet for lunch and then "learn how to learn together" for the rest of the afternoon.

A follow-up study of 14 such programs in three states revealed: (1) Although all of the children had been designated as being at risk for school failure as preschoolers, only 10 percent were still rated at risk by their current elementary school teachers. (2) More than 90 percent were considered by their current elementary school teachers as motivated to learn. (3) Not one of the children had to repeat any grade in elementary school.

The growth of the parents was no less dramatic. When asked to describe how their lives had changed as a result of the family literacy program, typical responses described improved self-confidence (nearly every participant) and self-control, passing high-school equivalency exams, admission to college, new jobs, and much better relations with their children. The children are described as more attentive to parents, eager to learn and -- in some cases for the first time -- hopeful about the future. Such programs could also be used in later grades for teaching mathematics, science, and much else.

* * *

In its early years, the United States boasted one of the highest -- perhaps the highest -- literacy rates in the world.

(Of course, slaves and women didn't count in those days.) As early as 1635, there had been public schools in Massachusetts. Political theorists came from other countries to witness this national wonder: vast numbers of ordinary working people who could read and write. The American devotion to education for all propelled discovery and invention, a vigorous democratic process, and an upward mobility that pumped economic vitality.

Today, the United States is not the world leader in literacy. Many of those judged literate are unable to read and understand very simple material -- much less a sixth-grade textbook, an instruction manual, a bus schedule, or a mortgage statement. And the sixth-grade textbooks of today are much less challenging than those of a few decades ago, while the literacy requirements at the workplace have become more demanding than ever before.

The gears of poverty, ignorance, hopelessness, and low self-esteem mesh to create a kind of perpetual failure machine that grinds down dreams from generation to generation. We all bear the cost of keeping it running. Illiteracy is its linchpin.

Even if we hardened our hearts to the shame and misery experienced by the victims, the cost of illiteracy to everyone else is severe -- the cost in medical expenses and hospitalization, the cost in crime and prisons, the cost in special education, the cost in lost productivity and in potentially brilliant minds who could help solve the dilemmas

besetting us. Even if we didn't have a trace of compassion in us, it would still make sense to take heroic steps to avoid undernutrition and malnutrition in fetuses, infants, and children, and to make reading available and attractive to all. It will not solve all our problems, but it will take us far. And it is an essential prerequisite for learning science.

Frederick Douglass taught that literacy is the path from slavery to freedom. There are many kinds of slavery and many kinds of freedom. But reading is still the path.

[Box:]

Frederick Douglass After the Escape

When he was barely twenty, he ran away to freedom. Settling in New Bedford with his bride, Anna Murray, he worked as a common laborer. Four years later Douglass was invited to address a meeting. By that time, in the North, it was not unusual to hear the great orators of the day -- the white ones, that is -- railing against slavery. But even many of those opposed to slavery thought of the slaves themselves as somehow less than human. On the night of August 16, 1841, on the small island of Nantucket, the members of the mostly Quaker Massachusetts Anti-Slavery Society leaned forward in their chairs to hear something new: a voice raised in opposition to slavery by someone who knew it from bitter personal experience.

His very appearance and demeanor destroyed the myth of the "natural servility" of African-Americans. By all accounts his eloquent analysis of the evils of slavery was one of the most brilliant debuts in American oratorical history. William Lloyd Garrison, the leading abolitionist of the day, sat in the front row. When Douglass finished his speech, Garrison rose, turned to the stunned audience, and challenged them with a shouted question: "Have we been listening to a thing, a chattel personal, or a man?"

"A man! A man!" the audience roared back as one voice.

"Shall such a man be held a slave in a Christian land?"
called out Garrison.

"No! No!" shouted the audience.

And even louder, Garrison asked: "Shall such a man ever be
sent back to bondage from the free soil of Old Massachusetts?"

And now the crowd was on its feet, crying out "No! No!
No!"

He never did return to slavery. Instead, as an author,
editor, and publisher of journals, as a speaker in America and
abroad, and as the first African-American to occupy a high
position in the U.S. government, he spent the rest of his life
fighting for human rights. During the Civil War, he was a
consultant to President Lincoln. Douglass successfully advocated
the arming of ex-slaves to fight for the North, Federal
retaliation against Confederate prisoners-of-war for Confederate
summary execution of captured African-American soldiers, and
freedom for the slaves as a principal objective of the war.

Many of his opinions were scathing, and ill-designed to win
him friends in high places:

I assert most unhesitatingly, that the religion of the South
is a mere covering for the most horrid crimes -- a justifier
of the most appalling barbarity, a sanctifier of the most
hateful frauds, and a dark shelter under which the darkest,
foulest, grossest, and most infernal deeds of slaveholders
find the strongest protection. Were I to be again reduced
to the chains of slavery, next to that enslavement, I should
regard being the slave of a religious master the greatest
calamity that could befall me. . . I. . . hate the corrupt,
slaveholding, women-whipping, cradle-plundering, partial and

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"Slavery is of God" they
used to say
said in ante-bellum times.

[(Box:) "Frederick Douglass After the Escape" (M, 11/28/94)] 15

hypocritical Christianity of this land.

Compared to some of the religiously inspired racist rhetoric of that time and later, Douglass' comments do not seem hyperbolic.

As one of many loathsome post-Civil War examples, Charles Carroll's The Negro a Beast (St. Louis: American Book and Bible House) taught its pious readers that "the Bible and Divine Revelation, as well as reason, all teach that the Negro is not human." In more modern times, some racists still reject the plain testimony written in the nucleic acids that all the races are not only human but nearly indistinguishable with appeals to the Bible as an "impregnable bulwark" against even examining the evidence.

Douglass addressed the white community in these words:

[Slavery] fetters your progress, it is the enemy of improvement; the deadly foe of education; it fosters pride; it breeds indolence; it promotes vice; it shelters crime; it is a curse of the earth that supports it, and yet you cling to it as if it were the sheet anchor of all your hopes.

In 1843, on a speaking tour of Ireland, ^{shortly before the potato famine,} he was moved by the dire poverty there to write home to Garrison: "I see much here to remind me of my former condition, and I confess I should be ashamed to lift my voice against American slavery, but that I know the cause of humanity is one the world over." And in 1848, at the Seneca Falls Convention, where Elizabeth Cady Stanton had the nerve to call for an effort to secure the vote for women, he was the only man of any ethnic group to stand in support.

[(Box:) "Frederick Douglass After the Escape" (M, 11/28/94)] 16

On the night of February 20, 1895 -- more than thirty years after Emancipation -- following an appearance at a women's rights rally with Susan B. Anthony, he collapsed and died, a true American hero.

[M, 11/28/94]

Chapter 20

~~TELEVISION~~ SIGNIFICANCE JUNKIES

~~[Epigraph to come.]~~ Epigraph from Ch 12.

I hope no one will consider me unduly cynical if I assert that a good first-order model of how commercial and public television programming work is simply this: Money is everything. In prime time, a single rating point difference is worth millions of dollars in advertising. Especially since the early 1980s, television has ^{become} ~~been~~ almost entirely profit-motivated. You can see this, say, in the decline of network news and news specials, or in the pathetic evasions that the major networks offered to circumvent a Federal Communications Commission mandate that they improve the level of children's programming. (For example, alleged educational virtues were touted of a cartoon series that systematically misrepresents the technology and lifestyles of our Pleistocene ancestors, and that portrays dinosaurs as pets.)

In this perspective, fighting for more real science on television seems naive and forlorn. But owners of networks and television producers have children and grandchildren about whose future they rightly worry. There is evidence that science programming can be successful, and that people hunger for more of it. ^{I remain} ~~So I'm~~ still hopeful that sooner or later we'll see real science skillfully and appealingly presented as a regular feature ^{major} ~~on~~ network of television worldwide.

* * *

Baseball and soccer have Aztec antecedents. Football is a thinly disguised re-enactment of hunting; we played it before we were human. Lacrosse is an ancient Native American game, and hockey is related to it. But basketball is new. We've been making movies longer than we've been playing basketball.

At first, they didn't think to make a hole in the peach basket so the ball could ~~readily~~ ^{without climbing a flight of stairs.} be retrieved. But in the brief time since then, the game has evolved. In the hands mainly of African-American players, basketball has become -- at its best -- the paramount synthesis in sport of intelligence, precision, courage, audacity, anticipation, artifice, teamwork, elegance, and grace.

Five-foot-three-inch Muggsy Bogues negotiates a forest of giants; Michael Jordan sails in from some outer darkness beyond the free-throw line; Larry Bird threads a precise, no-look pass; Kareem Abdul-Jabbar ~~releases~~ ^{unleashes} a skyhook. This is not fundamentally a contact sport like football. It's a game of finesse. The full-court press, passes out of the double-team, the pick-and-roll, cutting off the passing lanes, a tip-in from a high-flying forward soaring from out of nowhere all constitute a coordination of intellect and athleticism, a harmony of body and mind. It's not surprising that the game has caught fire.

Ever since NBA basketball became a television staple, it's seemed to me that it could be used to teach science and mathematics. To appreciate a free-throw average of 0.926, you must know something about converting fractions into decimals. A lay-up is Newton's first law of motion in action. Every shot represents the launching of a basketball on a parabolic arc, a curve determined by the same gravitational physics that specifies the flight of a ballistic missile, or the Earth orbiting the Sun, or a spacecraft on its rendezvous with some distant world. The center of mass of the player's body during a slam dunk is briefly in orbit about the center of the Earth.

To get the ball in the basket, you must loft it at exactly the right speed; a 1 percent error and gravity will make you look bad. Three-point shooters compensate for aerodynamic drag. Each successive bounce of a dropped basketball is nearer to the ground because of the Second Law of Thermodynamics. Daryl Dawkins or Shaquille O'Neal shattering a backboard is an opportunity for teaching -- among some other things -- the propagation of shock waves. A spin shot off the glass from under the backboard goes in because of the conservation of angular momentum. It's an infraction of the rules to touch the basketball in "the cylinder" above the basket; we're now talking about a key mathematical idea: generating n -dimensional objects by moving $(n - 1)$ -dimensional objects.

In classroom, newspapers, and television, why aren't we using sports to teach science?

When I was growing up, my father would bring home a daily paper and consume (often with great gusto) the baseball box scores. There they were, to me dry as dust, with obscure abbreviations (W, SS, SO, W-L, AB, RBI), but they spoke to him. Newspapers everywhere printed them. I figured maybe they weren't too hard for me. Eventually I too got caught up in the world of baseball statistics. (I know it helped me in learning decimals, and I still cringe a little when I hear, usually at the very beginning of the baseball season, that someone's "batting a thousand." But 1.000 is not 1,000. The lucky player is batting one.)

Or take a look at the financial pages. Any introductory material? Explanatory footnotes? Definitions of abbreviations? None. It's sink or swim. Look at those acres of statistics! Yet people voluntarily read the stuff. It's not beyond their ability. It's only a matter of motivation. Why can't we do the same with math, science, and technology?

* * *

In every sport the players seem to perform in streaks. In basketball it's called the hot hand. You can do no wrong. I remember a playoff game in which Michael Jordan, not ordinarily a

superb long-range shooter, was effortlessly making so many consecutive three-point baskets from all over the floor that he shrugged his shoulders in amazement at himself. In contrast, there are times when you're cold, when nothing goes in. When a player is in the groove he seems to be tapping into some mysterious power, and when ice-cold he's under some kind of jinx or spell. But this is magical, not scientific thinking.

Streakiness, far from being remarkable, is expected, even for random events. What would be amazing would be no streaks. If I flip a penny 10 times in a row, I might get this sequence of heads and tails: H H H T H T H H H H. Eight heads out of 10, and four in a row! Was I exercising some psychokinetic control over my penny? Was I in a heads groove? It looks much too regular to be due to chance.

But then I remember that I was flipping before and after I got this run of heads, that it's embedded in a much longer and less interesting sequence: H H T H T T H H H T H T H H H T H T T H T H T T. If I'm permitted to pay attention to some results and ignore others, I'll always be able to "prove" there's something exceptional about my streak. This is one of the fallacies we've discussed, "the enumeration of favorable circumstances." We remember the hits and forget the misses. If your ordinary field goal shooting percentage is 50 percent and you cannot improve your statistics by an effort of will, you're exactly as likely to have a hot hand in basketball as I am in

coin-flipping. As often as I get eight out of ten heads, you'll get eight out of ten baskets. Basketball can teach something about probability and statistics.

A study by my colleague Tom Gilovich, professor of psychology at Cornell, shows persuasively that our ordinary understanding of the basketball streak is a misperception. Gilovich studied whether baskets made by National Basketball Association players tend to cluster more than you'd expect by chance. After making one or two or three shots, players were no more likely to succeed than after a missed basket. This was true for the great and the near-great, not only for field goals but for free throws -- where there's no hand in your face. (Of course some attenuation of shooting streaks can be attributed to increased attention ^{by} ~~of~~ the defense to the player with the "hot hand.") In baseball, there's the related but contrary myth that someone batting below his average is "due" to make a hit. This is no more true than that a few heads in a row makes the chance of flipping tails next time anything other than 50 percent. If there are streaks beyond what you'd expect statistically, they're hard to find.

But somehow this doesn't satisfy. It doesn't feel true. Ask the players, or the coaches, or the fans. We seek meaning, even in random numbers. We're significance junkies. When the celebrated coach Red Auerbach heard of Gilovich's study, his response was: "Who is this guy? So he makes a study. I

couldn't care less." And you know exactly how he feels. But if basketball streaks don't show up more often than sequences of heads or tails, there's nothing magical about them. Does this reduce players to mere marionettes, manipulated by the laws of chance? Certainly not. Their average shooting percentages are a true reflection of their personal skills. This is only about the frequency and duration of streaks.

Of course, it's much more fun to think that the gods have touched the player who's on a streak and scorned the one with a cold hand. So what? What's the harm of a little mystification? It sure beats boring statistical analyses. In basketball, in sports, no harm. But as a habitual way of thinking, it gets us into trouble in some of the other games we like to play.

¶ "Scientist, yes; mad, no" giggles the mad scientist on "Rilligan's Island" as he adjusts the electronic device that permits him to control the minds of others for his own nefarious purposes.

¶ "I'm sorry, Dr. Nerdnik, the people of Earth will not appreciate being shrunk to 3 inches high, even if it will save room and energy. . . ." The cartoon superhero is patiently explaining an ethical dilemma to the typical scientist portrayed on Saturday-morning children's television. ¶ Many of these so-called scientists -- judging from the programs I've seen (and plausible inference about ones I haven't, ^{such as} ~~for example~~, the "Mad Scientist's 'Toon Club") -- are moral cripples driven by a lust for power or endowed with a spectacular insensitivity to the

adder
feelings of others. The message conveyed to the moppet audience is that science is dangerous and scientists ^{worse than} ~~are~~ weird. *They're*
crazed.

The applications of science, of course, can be dangerous, and, as I've tried to stress, virtually every major technological advance in the history of the human species -- back to the invention of stone tools and the domestication of fire -- has been ethically ambiguous. These advances can be used by ignorant or evil people for evil purposes or by wise and good people for the benefit of the human species. But only one side of the ambiguity ever seems to be presented on these offerings to our children.

There is no hint in such programs of the joys of science, the delights in discovering how the universe is put together, the exhilaration in knowing a deep thing well. And there's hardly a glimpse of the crucial contributions that science and technology have made to human welfare -- of the billions of lives saved or made possible by medical and agricultural technology.

We live in a complex age where many of the problems that are facing us can, whatever their origins, only have solutions that involve a deep understanding of science and technology. Modern society desperately needs the finest minds available to devise solutions to these problems. I do not think that many gifted youngsters will be encouraged toward a career in science or engineering by watching Saturday-morning television -- or much of the rest of the available American video menu.

[12-11-94.at1]

Quint M, Ch 20, p. 10

For The Demon-Haunted World:

A series called "The X Files" which pays lip service to skeptical examination of the paranormal is skewed heavily towards the reality of alien abductions and strange powers and government complicity in covering up the existence of such things. Almost never does the paranormal claim turn out to be a hoax or ^a psychological aberration or ^a misunderstanding of the natural world. It would be much closer to reality, ~~I believe~~, as well as a much greater public service to have a similar program in which paranormal claims are systematically investigated and every case found to be explicable in ^{prosaic} ~~other~~ terms. Perhaps one of the investigators would always be disappointed ~~at the prosaic explanation~~ and hope that next time an unambiguously paranormal case will survive skeptical testing. . .

Over the years, there's been a profusion of credulous, uncritical TV series and "specials" on ESP, remote cutlery warping, the Bermuda Triangle, UFOs, ancient astronauts, Big-Foot, and the like. The style-setting series In Search Of. . . begins with a disclaimer disavowing any responsibility to present a balanced view of the subject. You can see a thirst for wonder here untempered by even rudimentary scientific skepticism. Pretty much whatever anyone says on camera is true. The producers decide who's on camera. The idea that there might be alternative explanations to be decided among by the weight of evidence never surfaces. The same is true in Unsolved Mysteries -- in which, as the very title ^{suggests} ~~makes clear~~, prosaic solutions are ~~especially~~ unwelcome -- and many other clones.

In Search of. . . frequently takes an intrinsically interesting subject and systematically distorts the evidence. If there is a mundane scientific explanation and one which requires the most extravagant paranormal or psychic explanation, you can be sure that the latter will be highlighted. An almost random example: An author is presented who argues for a major planet beyond Pluto. His evidence is cylinder seals from ancient Sumer. His views are increasingly accepted by professional astronomers, he says. Not a word is mentioned of the failure of astronomers -- studying the motions of Neptune and the four spacecraft beyond Neptune -- to find a trace of the alleged planet.

The graphics are indiscriminate. When an offscreen narrator is talking about dinosaurs, we see a woolly mammoth. The narrator describes a hovering aircraft; the screen shows a shuttle liftoff. We hear about lakes and flood plains, but are shown mountains. It doesn't matter. The visuals are as indifferent to the facts as is the voice-over.

Quoted M ^{Other} comparable shortcomings are evident in television science fiction programming. Star Trek, for example, despite its charm and strong international and interspecies perspective, often ignores the most elementary scientific facts. The idea that Mr. Spock could be a cross between a human being and a life form independently evolved on the planet Vulcan is genetically far less probable than a successful hybrid of a man and an artichoke.

In many TV programs and films, even the casual science -- the throwaway lines that are not essential to a plot already innocent of science -- is done incompetently. It costs very little to hire a graduate student to read the script for scientific accuracy. But, so far as I can tell, this is almost never done. As a result we have such howlers as "parsec" as a unit of speed instead of distance in the -- in many ^{casually mentioned} other ways ^{modicum of} exemplary -- film Star Wars. If such things ^{with a little care,} ^{are done correctly,} ^{even} ^{they} might improve the plot; certainly, they might ^{convey a little} ~~diminish a~~ ^{help} ~~little the viewers' confusion about science,~~ ^{to a mass audience.}

9 By far the most effective means of raising interest in science is television. *9* There's a great deal of pseudoscience for

the gullible on TV, a fair amount of medicine and technology, but hardly any science -- especially on the five big commercial networks, whose executives ^{tend to} think ^{that} science programming means ratings declines and lost profits, and nothing else matters.

There are network employees with the title "Science Correspondent," and an occasional news feature said to be devoted to science, but we almost never hear any science from them, just medicine and technology. In all the networks, I doubt if there's a single employee whose job it is to read each week's issues of Nature and Science to see if anything newsworthy had been discovered. When the Nobel Prizes in science are announced each fall, there's a superb news "hook" for science: a chance to explain what the prizes were given for. But, almost always, all we hear is something like ". . . may one day lead to a cure for cancer. Today in Belgrade. . . ." How much science is there on

^{radio or television} the talk shows, or on those dreary Sunday ^{morning} programs in which middle-aged white males sit around agreeing with each other? When is the last time you heard an intelligent ~~unprogrammed~~ comment on science by a President of the United States? Why in all America is there no TV drama that has as its hero someone devoted to figuring out how the Universe works? When a highly publicized murder trial has everyone casually mentioning DNA testing, where are the network specials devoted to nucleic acids and heredity? I can't even recall seeing an accurate and comprehensible description on television of how television works.

→ But this enormously powerful medium is doing close to nothing to ~~get~~ convey the joys and methods of science, while its "mad scientist" engine continues to puff away.

In American polls in the early 1990s, two-thirds of adults had no idea what the "information superhighway" was; 42 percent didn't know where Japan is; and 38 percent were ignorant of the term "Holocaust." But the proportion was in the high 90s who had heard of the Menendez, Bobbitt, and O. J. Simpson criminal cases, and 99 percent had heard that the singer Michael Jackson *had* allegedly sexually molested a boy. The United States may be the best-entertained nation on Earth, but a steep price is being paid.

Surveys in Canada and in the United States in the early 1990s show that television viewers wish there were more science programming. Occasionally there is a good science program in the Nova series of the Public Broadcasting Service, or on the Discovery Channel, or by the Canadian Broadcasting Company. Bill Nye's "Science Guy" programs for children on PBS show excellent pace, arresting graphics, diversified science, and some nice funny parts. But the depth of public interest in science if presented engrossingly and accurately -- to say nothing of the immense good that would result from better public understanding of science -- is not yet reflected in network programming.

** Ch 22, p-7* → The German philosopher Arthur Schopenhauer opined:

The majority of men. . . are not capable of thinking, but only of believing, and. . . are not accessible to reason, but only to authority.

~~This gloomy assessment (which I imagine engraved over the portals of the network programming chiefs) is a misreading of "the~~

~~majority of men~~ -- ~~and women~~. ^{general} My own best insight into science and the public is drawn from the 13-part television series Cosmos, which premiered in America in 1980. With the Public Broadcasting System in America, Cosmos was a joint production of the BBC in Britain, Polytel in Germany, and the Asahi Broadcasting Corporation in Japan. Mainly, it was an exposition of some of the findings of modern science -- astronomy, physics, chemistry, biology -- with an occasional excursion into how we found out. We built on the theme of cosmic evolution and the natural human interest in myths of origins. It helped that the series was visually spectacular with state-of-the-art computer graphics, and that we had the world's great music to draw upon.

Cosmos was outrageously successful, but the nature of its success was particularly ~~striking~~. ^{unexpected.} One of the multitude of letters we received will give you an idea. This from a woman viewer: "My father is an over-the-hill truck driver. We haven't had a serious conversation in 20 years. When 'Cosmos' was on, he would come over every Sunday to watch it. ^{After,} We would ~~get to~~ ^{for hours.} talking. Thanks for bringing ~~me~~ ^{and I me} and my father together."

We received thousands of letters in the first year. Many were from people -- especially women -- who told us how they had been intimidated in their schooling, convinced that they had no "head" for science and mathematics, that they were too stupid to understand. Naturally they felt disenfranchised, rejected by their own culture. "But I understood nearly everything in

Cosmos was the repeated motif of these letters. Many decided to go back to college and ^{immerse themselves in} ~~learn~~ the subjects they had been discouraged from learning. Young people vowed they would go into science -- to study whales or electrical engineering or molecular biology, or explore planets, or become historians of science, or understand the Big Bang. Since 1980, I've heard from a whole generation of scientists and science teachers who were stimulated ^{to pursue their careers} and motivated by Cosmos. ~~I think~~ The total number must easily be in the thousands. ~~And~~ ^{Its} appeal somehow went beyond the mere presentation of facts: The matron of a home for autistic adults in Britain wrote to say that Cosmos was the only regularly-scheduled program that her charges would routinely assemble for, in eager anticipation, Mothers of one- and two-year-old children wrote to say that there was something about Cosmos -- and it could hardly have been my explanations -- that transfixed their children.

Cosmos became the most widely watched television series in the history of the Public Broadcast System. It has now been seen in more than 60 countries by over half a billion people. It slipped across the political divides and was viewed in communist and capitalist countries, in Israel and Saudi Arabia, by atheists and monks. I've been buttonholed about it by a Malaysian tourist, babe in arms, who found me at the Sydney, Australia, zoo; by Soviet scientists; by Indian prime ministers.

Annie Druyan and I once were passing through Customs at New York's Kennedy Airport when the ~~C~~ustoms inspector looked us over acutely and then gruffly asked us to accompany him to his supervisor. While as far as we knew we were innocent of any customs violation, the circumstance nevertheless aroused a little anxiety. The two of them scowled at us: "Dr. Sagan, Ms. Druyan, we don't think you gave Plato a fair shake in Cosmos. And there was too much emphasis on the presocratic philosophers. . ."

Once, a decade after Cosmos was first shown, at Union Station in Washington, DC, I attempted to tip the porter who had carried our bags all the way from the curb to the railway car. He waved his hand from side to side: "On, no, sir, I couldn't take anything from you. You gave me the Universe."

In Japan Cosmos was shown on 13 consecutive nights and repeated many times over the succeeding months. For years, it seemed, you could not travel on domestic flights of Japan Air Lines without having a bit of Cosmos foisted on you. The word "Cosmos" was picked up by a magazine, an automobile, a brand of cigarettes, and a corrupt company ("Recruit Cosmos") ~~{check}~~ whose bribes brought down a Japanese government.

* * *

It's?

Here are some possibilities:

*770
why not*

If I could, ~~how~~ ^{we} would I put more science on television? I'd do gripping user-friendly programs for children, others for

adults. ~~I'd display~~ ^{presented} the wonders of science routinely on news and talk programs. ~~I'd institute~~ ^A a series called "Solved Mysteries," in which tremulous speculations have prosaic resolutions, including puzzling cases in forensic medicine and epidemiology; ~~and~~ ^A another series on fundamental misunderstandings and mistakes made by famous scientists, national leaders, and religious figures. ~~I'd organize~~ ^{A.P.} regular exposés of pernicious pseudoscience, and audience-participation "how-to" programs: how to bend spoons, read minds, appear to foretell the future, perform psychic surgery, do cold reads, and press the TV viewers' buttons. How we're bamboozled: Learn by doing. ~~I'd establish~~ ^A a state-of-the-art computer graphics facility to prepare scientific visuals for a wide range of news contingencies. ~~I'd do~~ ^{A. Series 1} series with the flavor of Cosmos in many realms of science and technology.

There are plenty of inexpensive ways to convey science that are at least as interesting as run-of-the-mill collective ruminations of "Washington insiders." For example, consider a televised debate on the shape of the Earth. It would begin with a presentation of the traditional arguments. For example: "Just step outside and take a look. The world is flat." (In America, this argument is more persuasive in the Central Time Zone.) There would be arguments in favor of the flatness of the Earth on the grounds that it's a traditional belief, that respectable people -- scientists, philosophers, popes, kings, culture heroes

-- held ^{to flatness} ~~this view~~ over all of our history. We would hear passages from famous books, secular and religious, attesting ~~to the claim~~ that the Earth is flat. There are still some people who hold these views. ^{Invite them on.} Let the Flat Earthers take their best shot.

Then let's talk about the mast of a ship disappearing last as the ship sails away, the curvature of the Earth's shadow on the Moon during a lunar eclipse, the Foucault pendulum experiment, and photographs of the Earth from space. But note that to describe these lines of evidence takes more than a three-minute sound bite. If the debate were on a network ~~catering to the impatience~~ ^{about} ~~over~~ extended discourse, ^{an attitude that} ~~that~~ characterizes the medium today, you can foresee the round-Earthers doing rather poorly. The flat-Earther says, Sail out into the ocean, look around you, and isn't it clear the Earth is flat?; and by the way, those photos of the Earth being round were faked, and as for Magellan, he sailed around the Earth only in the sense that a needle goes around a phonograph record. That you can describe in three minutes. But the Foucault pendulum experiment and the rest, you cannot.

~~It's fun to~~ I imagine a set of such televised debates, each perhaps an hour long, with a computer graphics budget for each side provided by the producers, rigorous standards of evidence required by the moderator, and the widest range of topics broached. They could address issues where the scientific

evidence is overwhelming, as on the matter of the shape of the Earth; controversial matters where the answer is less clear, such as the survival of one's personality after death, or abortion, animal rights, or genetic engineering; or any of the ^{presumptive pseudosciences} ~~subjects~~ ^{mentioned} discussed in this book.

There is a pressing national need for more public knowledge of science. Television cannot provide it all by itself. But if we want to make short-term improvements in the understanding of science, television is the place to start.

[Box:]

A Debate

[In italics:]

✓ In 1987 ^{December} ~~[early 1988?]~~, I attended a gathering sponsored by the Scientists' Institute for Public Information, a public interest organization that has been trying to bring scientists and the mass media together. (It's on the way to this meeting, ~~incidentally~~, that I met "Mr. Buckley," as described in Chapter 2.) A debate was arranged between the celebrated NBC correspondent John Chancellor and myself on whether science ought to be offered any special access to commercial television. With the permission [check] of Mr. Chancellor, I here reproduce a part of this debate: [end of italics]

CHANCELLOR:

A lot of us did learn the arcana of American baseball box scores because our fathers and friends were interested in baseball. One of the problems today is that our fathers aren't interested in science. Recently, the United States has gone through a period when the public in general has been less concerned with the public good than with private gain. As a society, we have slipped. We have become soft and flaccid in a lot of things we are doing: funding schools, raising educational

standards, generally competing with the world. The situation has impacted on the attitude of Americans towards science and technology.

There is a great deal of interest in the latest Japanese-designed consumer electronics, but there's very little interest in the Princeton fusion project. Is that a failure of journalism? Journalism expresses the directions that a society is heading and reports what interests it. I'm not sure that we can change that very much. Our TV editors and producers and reporters are Americans. They can be off-base just as much as everybody else in the United States.

Journalism in the United States tends to reflect and report on the state of society. It does not lead society. That's true of the printed media and Hollywood, too. I don't think that is necessarily a bad thing. I have worked as a journalist in countries where television and all the press are at the service of the government. I remember in Moscow, for example, the only commercials on VREMYA and other programs were for drinking milk. They certainly made no impression on the vodka-drinking Russians. Social engineering, through the media, has been tried for years in closed societies, and it hasn't worked.

We ought to be able to educate Americans better through television, both from the journalistic side and the "confection," or non-journalistic, side of television. But what are the goals of television? Do we want American fathers to tell their sons,

"It's not just the RBIs that you ought to be interested in, kid. It's quantum indeterminacy. Now get in there and hit the books"?

It might be doable. Television might influence kids to hit the books. If we were able to take over American television and appoint television programmers as social engineers, we might interest a few youngsters in quantum indeterminacy and more science. However, I am not sure that television is all that powerful and influential a medium, especially television news. As Reuven Frank has frequently pointed out, television isn't so good at conveying facts, but it's terrific at the transmission of experience.

For example, when OPEC raised prices in 1973 and the first oil shock hit the United States, I was a television anchorman. Night after night, then and later with the next oil shock in 1978, we showed pictures of long lines at the gas stations and reported the amount of oil we imported. A 1979 Gallup Poll discovered that 50 percent of the American people thought that the United States did not import a single drop of foreign oil! I was crushed.

That is just one of the endless demonstrations of the inadequacy of television to convey information. We in the industry are well aware of the problem. Our perception contrasts sharply with the belief of others who are not in television. They think that if only we pressed the right social engineering buttons that the country would, in some miraculous fashion,

improve.

It interests me, fascinates me, and troubles me that many different groups in the United States think that if only television were better, people would be better and the country would be better. That belief inevitably conflicts with one of our cherished freedoms: a free press. American television, whether you rate it as good or bad, is free.

Many would like to see all the media a little less free, if it would help their causes or further their goals. They don't want any other element of American life to be less free. I wouldn't know to what degree or how to curtail the freedom of our media, television included, even if we could be sure that it would keep the country from going down the chute. And the minute I gave you a precisely painted picture of what I think the function of journalism in the United States should be, it would no longer be American-style journalism.

Science is in bad shape in the United States. We need to know more about it, understand it better. But the impetus must come from the community, from society itself. We cannot expect television to take the initiative.

SAGAN:

How can presenting more science on commercial television be described as social engineering? We're trying to raise the level of scientific literacy in the nation and to get kids interested

in science so that they can be more productive, so that the economic base can be raised, so that people will be smarter. We are not asking for programs of exhortation -- to drink milk or to study quantum mechanics. We're talking about science programming so appealing that the viewers are drawn in and suddenly discover a subject that they didn't even realize was interesting to them. It happened to millions who watched Cosmos and Nova.

We can't expect to reach all the viewers, anymore than you reached all the viewers of your oil-shock story. But if we reach 10 percent of the audience who didn't realize that they were interested in science, we could expect enormous changes in the future.

CHANCELLOR:

You would like more science programs on the air because if we engage 10 percent of the young people in the United States that would have a big payoff in future years? Why should television do that?

SAGAN:

So we have that big payoff. Otherwise, the country will be in worse shape; people will be less satisfied because they will not understand the world around them.

CHANCELLOR:

Well, I agree that we have got to do science better, but I am not sure how. There are a lot of wonderful things that prime-time television could do for the advancement of science in the United States -- news, hour-long shows, sitcoms and movies, all featuring science. But do we manipulate the media or demand that the media send the message? Or should we be smart enough and mature enough to expect the lack of science education to be addressed by the politicians, the clergy, and by other members of American society who are supposed to be influential: university presidents, academics, intellectuals? I haven't heard any President in the past 20 years fully advance an agenda for science. Nobody in the Congress or in the pulpits is getting up to say science is what we really should concentrate on. If they say it, television will report it. But if they don't say it, the media should not be expected to create the interest and promote the agenda.

SAGAN:

We are not asking the media to create interest and promote an agenda. There are science stories out there every day. But there is a filter at the networks; the stories don't get through. That is a sort of social engineering. But science should be presented on television because it is intrinsically interesting and phenomenally entertaining.

[M, 11/28/94]

Chapter 21

THE CURIOSITY OF THE NERDS

Why should we subsidize intellectual curiosity?

-- Ronald Reagan, campaign speech, 1980

Stereotypes abound. Ethnic groups are stereotyped, the citizens of other nations and religions are stereotyped, the genders and sexual preferences are stereotyped, people born in various times of the year are stereotyped (this is called Sun-sign astrology), occupations are stereotyped. The most generous interpretation ^{ascribes it to} ~~sees it as~~ a kind of intellectual laziness: Instead of judging people on their individual merits and deficits, we concentrate on one or two bits of information about them, and then place them in a small number of previously constructed pigeonholes.

This saves the trouble of thinking, but in many cases it commits a profound injustice. It also shields the stereotyper from knowing the enormous variety of people, the multiplicity of ways of being human. Even if stereotyping were valid on average, it is bound to fail in many individual cases: Human variation runs to bell-type curves. There's an average ^{value of} ~~in~~ any quality, and smaller numbers of people running off in both extremes.

Some stereotyping is the result of not controlling the variables, of forgetting what other factors might be in play. For example, it used to be that there were almost no women in

science. Many male scientists were vehement: This proved that women lacked the ability to do science. ~~it~~ ^{it didn't} Temperamentally ~~did~~ not fit them, it was too difficult, it required a kind of intelligence that women don't have, they're too emotional to be objective, can you think of any great women theoretical physicists?, and so on. Since then the barriers have ^{tumbling} come down. Today women populate most of the subdisciplines of science. In my own fields of astronomy and planetary studies, women have recently burst upon the scene, making discovery after discovery, and providing a desperately needed breath of fresh air.

So what data were they missing -- all those famous male scientists of the 1950s and '60s and earlier who had pronounced so authoritatively on the intellectual deficiencies of women? Plainly, the society was preventing women from entering science, and then criticizing them for it: ¶ You want to be an astronomer, young woman? Sorry, ~~you can't~~. ¶ Why not? Because you're unsuited for it. ¶ How do ^{we} you know ^{you're} I'm unsuited? Because women have never been astronomers. ¶ (Why have women never been astronomers? Because men kept them out.) ¶ Put so baldly, the argument sounds absurd. But the contrivances of bias can be subtle. The despised group is rejected by spurious appeals to doctored data, ^(some of) sometimes done with such confidence and contempt including the victims themselves, that many of us fail to recognize it as self-serving sleight of hand.

Casual observers of meetings of skeptics, and those who glance at the list of CSICOP Fellows, have noted a great preponderance of men. Some commentators suggest that there is something peculiarly male about skepticism. It's hard-driving, competitive, confrontational, tough-minded -- whereas women, they say, are more accepting, consensus-building, and uninterested in challenging conventional wisdom. But in my experience many women scientists have finely-honed skeptical senses; that's just part of being a scientist. This criticism, if that's what it is, is *outfitted in another ragged disguise.* ~~another accoutrement of sexism~~ If you discourage women from being skeptical and don't train them in skepticism, sure enough you may find that many women aren't skeptical. Open the doors and let them in, and they're as skeptical as anybody else.

One of the stereotyped occupations, ~~I find~~, is science. Scientists are nerds, socially inept monomaniacs, working on some incomprehensible subject that no normal person would find in any way interesting -- even if he were willing to invest the time required, which, again, no sensible person would. "Get a life," you might want to tell them.

I asked for a fleshed-out contemporary characterization of scientist-nerds from an expert on eleven-year-olds of my acquaintance. I should stress that she is merely reporting, not necessarily endorsing, the conventional prejudices:

Nerds wear their belts just under their rib cages. Their short-sleeve shirts are equipped with pocket protectors in which

is displayed a formidable array of multicolored pens and pencils.

^{programmable}
A calculator is carried in a special belt holster. They all wear thick glasses with broken nose-pieces that have been repaired with Band-Aids. When they laugh, what comes out is a snort. They are loners, but sometimes they jabber at each other in an incomprehensible language. They'll jump at the opportunity to work for extra credit in all classes except gym. They look down on normal people, who in turn laugh at them. Most ~~scientist~~ nerds have nerdish names like Norman. (The Norman Conquest involved a horde of high-belted, pocket-protected, calculator-carrying nerds with broken glasses invading England.) There are more boy nerds than girl nerds, but there are plenty of both. Nerds don't date. If you're a nerd you can't be cool. Also vice versa.

This of course is a stereotype. There are scientists who dress elegantly, who are devastatingly cool, who many people long to date, who do not carry concealed calculators. Some you'd never guess were scientists if you invited them to your home.

But other scientists do match the stereotype, more or less. They're pretty socially inept. There may be, proportionately, many more nerds among scientists than among backhoe operators or highway patrol officers. Perhaps scientists are more nerdish than bartenders or salesmen or short-order cooks. Why should this be? Maybe people untalented in getting along with others find a refuge in impersonal pursuits, particularly mathematics

and the physical sciences. Maybe the serious study of difficult subjects requires so much time and dedication that very little is left over for learning more than the barest social niceties. Maybe it's a combination of both.

So what? What's wrong with a little good-natured fun at the expense of science? But like the mad-scientist image, to which it's closely related, the nerd-scientist stereotype is pervasive in our society. If, for whatever reason, people dislike the stereotypical scientist, they are less likely to support science. Why subsidize nerds to pursue their absurd and incomprehensible little projects? Well, we know the answer to that: Science is subsidized because it provides spectacular benefits at all levels in the society, as I have argued earlier in this book. So those who find nerds distasteful, but at the same time crave the products of science, face a kind of dilemma. A tempting resolution is to direct the activities of the scientists. Don't give them money to go off in weird directions, but tell them what we need -- this invention, or that process. Subsidize not the curiosity of nerds, but what will benefit the society. It seems simple enough.

The trouble is that ordering someone to go out and invent something, even if price is no object, hardly guarantees that it gets done. There may be an underpinning of knowledge that's unavailable, without which no one will ever make the invention. And the history of science shows that often you can't go after

the underpinnings in a directed way, either. They ^{may} emerge out of the ^{idle} musings of some lonely young person off in the boondocks.

They're ignored or rejected ^{even} by other scientists, sometimes until a new generation of scientists comes along. ~~Letting~~ ^{major} promoting practical

inventions and discouraging curiosity-driven research can

^{be spectacularly ineffective.} ~~accomplish exactly the opposite of what is intended by practical people in a hurry.~~

* * *

Suppose: You are, by the Grace of God, Victoria, Queen of Great Britain and Northern Ireland, Empress of India, and Defender of the Faith, ^N in the most prosperous and triumphant age of the British Empire. Your dominions stretch across the planet. Maps of the world are abundantly splashed with British pink. You preside over the world's leading technological power. The steam engine was perfected in Great Britain, largely by Scottish engineers -- who provide technical expertise on the railroads ^{ways} and steamships that bind up the Empire.

Suppose around the year 1860 you have a visionary idea, so daring it would have been rejected by Jules Verne's publisher. You want a machine that will carry your voice, as well as moving pictures of the glory of the Empire, into every home in the kingdom. What's more, the sounds and pictures must come not through conduits or wires, but somehow out of the air -- so

people at work and in the field can receive instantaneous inspirational offerings designed to insure loyalty and the work ethic. The Word of God could also be conveyed by the same contrivance. Other socially desirable applications would doubtless be found.

So with the Prime Minister's support, you convene the Cabinet, the Imperial General Staff, and the leading scientists and engineers of the Empire. You will allocate a million pounds, you tell them -- big money in 1860. If they need more, just ask. You don't care how they do it; just get it done. Oh, yes, it's to be called the Westminster Project.

Probably ~~Conceivably~~ there ~~might~~ *would* be some useful inventions emerging *out of* ~~from~~ such an endeavor. *There always are when you spend huge amounts of money on technology.* But the Westminster Project would almost certainly fail. Why? Because the underlying science hadn't been done. By 1860 the telegraph was in existence. You could imagine at great expense telegraphy sets in every home. But that's not what the Queen asked for. If electricity flowed into every home, you might barely envision something like the telephone. But that's not what the Queen asked for, either. Radio and television were simply beyond reach.

In the real world, the physics necessary to invent radio and television would come from an intellectual direction that no one could have predicted:

James Clerk Maxwell was born in Edinburgh, Scotland in 1831. At age two he found that he could use a tin plate to bounce an

image of the Sun off the furniture and make it dance against the walls. As his parents came running he cried out, "It's the Sun! I got it with the tin plate!" In his boyhood, he was fascinated by bugs, grubs, rocks, flowers, lenses, machines. "It was humiliating," later recalled his aunt Jane, "to be asked so many questions one couldn't answer by a child like that."

Naturally, by the time he got to school he was called "Dafty" -- daft being a Britishism for not quite right in the head. He was an exceptionally handsome young man, but he dressed carelessly, for comfort rather than style, and his Scottish provincialisms in speech and conduct were a cause for derision, especially by the time he reached college. And he had peculiar interests. ⁴ Maxwell was a nerd.

He fared little better with his teachers than with his fellow students. Here ¹⁵ is a poignant couplet he wrote at the time:

Ye years roll on, and haste the expected time
When flogging boys shall be accounted crime.

Many years later, in 1872, in his inaugural lecture as professor of experimental physics at Cambridge University, he alluded to the nerdish stereotype:

It is not so long ago since any man who devoted himself to geometry, or to any science requiring continued application, was looked upon as necessarily a misanthrope, who must have abandoned all human interests, and betaken himself to abstractions so far removed from all the world of life and action that he has become insensible alike to the attractions of pleasure and to the claims of duty.

I suspect that "not so long ago" was Maxwell's way of recalling

the experiences of his youth. He then went on to say,

In the present day, men of science are not looked upon with the same awe or with the same suspicion. They are supposed to be in league with the material spirit of the age, and to form a kind of advanced Radical party among men of learning.

We no longer live in a time of untrammelled optimism about the benefits of science and technology. We understand that there is a downside. Circumstances today are much closer to what Maxwell remembered from his childhood.

He made enormous contributions to astronomy and physics -- from the conclusive demonstration that the rings of Saturn were composed of small particles, to the elastic properties of solids, to the disciplines now called the kinetic theory of gases and statistical mechanics. It was he who first showed that an enormous number of tiny molecules, moving on their own and incessantly colliding with each other, leads not to confusion, but to precise laws that apply statistically. The properties of such a gas can be predicted and understood. (The bell-shaped curve that describes the speeds of molecules in a gas is now called the Maxwell-Boltzmann distribution.) He invented a mythical being, now called "Maxwell's demon," whose actions generated a paradox that took modern information theory and quantum mechanics to resolve.

The nature of light had been a mystery since antiquity. There were acrimonious learned debates on whether it was a particle or a wave. Popular definitions ran to the style, "Light is darkness -- lit up." Maxwell's greatest contribution was his

discovery that electricity and magnetism, of all things, join together to become light. The now conventional understanding of the electromagnetic spectrum -- running in wavelength from gamma rays to x-rays to ultraviolet light to visible light to infrared light to radio waves -- is due to Maxwell. So is radio, television, and radar.

But Maxwell wasn't after any of this. He was interested in how electricity makes magnetism and vice versa. I want to describe what Maxwell did, but his historic accomplishment is highly mathematical. In a few pages, I can at best give you only a flavor. If you do not fully understand what I'm about to say, please bear with me. There's no way we can get a feeling for what Maxwell did without looking at a little mathematics.

Mesmer, the inventor of "mesmerism," believed he had discovered a magnetic fluid, "almost the same thing as the electric fluid," that permeated all things. On this matter as well, he was mistaken. We now know that there is no special magnetic fluid, and that all magnetism -- including the power that resides in a bar magnet -- is due to moving electricity. The Danish physicist Hans Christian Oersted had performed a little experiment in which electricity was made to flow down a wire and induced a nearby compass needle to waver and tremble. The wire and the compass were not in physical contact. The great English physicist Michael Faraday had done the complementary experiment: He made a magnetic force turn on and off and

generated a current of electricity in a nearby wire. Time-varying electricity had somehow reached out and generated magnetism, and time-varying magnetism had somehow reached out and generated electricity. This was called "induction" and was deeply mysterious, *close to magic.*

Faraday proposed that the magnet had an invisible "field" of force that extended into surrounding space, stronger close to the magnet, weaker ^a further away. You could track the form of the field by ~~putting~~ ^{placing} tiny iron filings on a piece of paper and waving a magnet underneath. Likewise, your hair after a good combing on a high-humidity day generates an electric field which invisibly extends out from your head, and which can even make small pieces of paper move by themselves.

The electricity in a wire, we now know, is caused by submicroscopic electrical particles, called electrons, which respond to an impressed electric field and move. The wires are made of materials like copper which have lots of free electrons -- electrons not bound within atoms, but free to move. Unlike copper, though, most materials, like wood, are not good conductors; they are ^a instead insulators or "dielectrics." In them there are ^{comparatively} ~~only~~ a few electrons available to move in response to the impressed electric or magnetic field. Not much of a current is produced. Of course there's some movement or "displacement" of electrons, and the bigger the electric field, the more displacement occurs.

["The Curiosity of the Nerds" (M, 11/28/94)]

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Maxwell devised a way of writing down what was known about electricity and magnetism in his time, a method of summarizing precisely all those experiments with wires and currents and magnets. Here they are, the four Maxwell equations for the behavior of matter:

[Insert Box 1.]

It takes a few years of university-level physics to really understand these equations. They are written using a branch of mathematics called vector calculus. A vector, written in bold-face type, is any quantity with both a magnitude and a direction. Sixty miles an hour isn't a vector, but sixty miles an hour due north on Highway 1 is. \mathbf{E} and \mathbf{B} represent the electric and magnetic fields. The triangle, called a nabla (because of its resemblance to a certain ancient Middle Eastern harp), expresses how the electric or magnetic field varies in three-dimensional space. The "dot product" and the "cross product" are statements of different kinds of variation. $\dot{\mathbf{E}}$ and $\dot{\mathbf{B}}$ represent the time variation, the rate of change of the electric and magnetic fields. j stands for an electrical current. The lower-case Greek letter ρ (rho) represents the density of electrical charges, while ϵ_0 (pronounced "epsilon zero") and μ_0 (pronounced "mu zero") are not variables, but constants of Nature determined by experiment.

[I, 9/20/94]

(Content, Box 1, Chapter 18:)

Maxwell's Equations in Matter

$$\nabla \cdot \mathbf{E} = \rho/\epsilon_0$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = - \dot{\mathbf{B}}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{j} + \mu_0 \epsilon_0 \dot{\mathbf{E}}$$

(Content, Box 2:)

Maxwell's Equations in Empty Space

$$\nabla \cdot \mathbf{E} = 0$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = - \dot{\mathbf{B}}$$

$$\nabla \times \mathbf{B} = \mu_0 \epsilon_0 \dot{\mathbf{E}}$$

Considering how many different quantities are being brought together in these equations, it's striking how simple they are. They could have gone on for pages, but they don't.

The first of the four Maxwell equations tells how an electric field due to electrical charges (electrons, for example) varies with distance (it gets weaker the farther away we go). But the greater the charge density, the stronger the field.

The second equation tells us that there's no comparable statement in magnetism, because Mesmer's magnetic "charges" (or magnetic "monopoles") do not exist: Saw a magnet in half and you won't be holding an isolated "north" pole and an isolated "south" pole; each piece now has two poles.

The third equation tells us how a changing magnetic field induces an electric field.

The fourth describes the converse -- how a changing electric field (or an electrical current) induces a magnetic field.

The four equations are essentially distillations of two generations of laboratory experiments, mainly by French and British scientists. What I've described here vaguely and qualitatively, the equations describe exactly and quantitatively.

Maxwell then asked himself a strange question: What would these equations look like in empty space, in a vacuum, in a place where there were no electrical charges and no electrical currents? ~~We might very well anticipate no electric and no magnetic fields in a vacuum.~~ ^{Instead,} He suggested that the right form

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["The Curiosity of the Nerds" (M, 11/28/94)]

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of the Maxwell equations for empty space is this:

[Insert Box 2.]

He ~~had~~ set ρ equal to zero, indicating that there are no electrical charges. He ^{also} set j equal to zero, indicating that there are no electrical currents. But he didn't discard the last term in the fourth equation, $\mu_0 \epsilon_0 \dot{E}$, the feeble displacement current in insulators.

Why not? As you can see from the equations, Maxwell's intuition preserved the symmetry between the magnetic and electric fields. Even in a vacuum, in the total absence of electricity, or even matter, a changing magnetic field ^{he proposed,} elicits an electric field and vice versa. The equations were to represent Nature, and Nature is, Maxwell believed, beautiful and elegant. This essentially esthetic judgment by a nerdish physicist, entirely unknown except to a few other academic scientists, has done more to shape our civilization than any ten recent presidents and prime ministers.

When the equations were written down like this, Maxwell was readily able to show that E and B propagated through empty space as if they were waves. What's more, the velocity of the wave could be calculated. It was just 1 divided by the square root of ϵ_0 times μ_0 . But ϵ_0 and μ_0 had been measured in the laboratory. When you plugged in the numbers you found that the

electric and magnetic fields in a vacuum ought to propagate, astonishingly, at the speed of light. The agreement was too close to be ~~an~~ ^{al} accident. Suddenly, disconcertingly, electricity and magnetism were deeply implicated in the nature of light.

Since light waves now appeared to derive from electric and magnetic fields, Maxwell called them electromagnetic. Those obscure experiments with batteries and wires had something to do with the brightness of the Sun, with how we see, with what light is. Ruminating on Maxwell's discovery many years later, Albert Einstein wrote, "To few men in the world has such an experience been vouchsafed."

Maxwell himself was baffled by the results. The vacuum seemed to act like a dielectric. He said that it can be "electrically polarized." Living in a mechanical age, Maxwell felt obliged to offer some kind of mechanical model for the propagation of an electromagnetic wave through a perfect vacuum. So he imagined space filled with a mysterious substance he called the aether, which supported and contained the time-varying electric and magnetic fields -- something like a throbbing but invisible Jell-O permeating the Universe. The quivering of the

aether was the reason that light traveled through it, -- just as water waves propagate through water and sound waves through air.

But it had to be very odd stuff, this aether, very thin, ghostly, almost incorporeal. The Sun and the Moon, the planets and the stars had to pass through it without being slowed down, without noticing. And yet it had to be stiff enough to support

all these propagating waves.

The word aether is still, in a desultory fashion, in use, in English mainly in the adjective ethereal -- residing in the aether. It has some of the same connotations as the more modern "spacy" ^{or} and "spaced out." When, in the early days of radio, they would say "On the air," the aether is what they had in mind.

(The Russian phrase is quite literally "on the aether," в эфире.) But of course radio readily travels through a vacuum, one of the main results of Maxwell's findings. It doesn't need air to propagate. The presence of air is, if anything, an impediment.

The whole idea of light and matter moving through the aether was to lead in another forty years to Einstein's special theory of relativity, $E = mc^2$, and a great deal else. Relativity, and experiments leading up to it, showed conclusively that there is no luminiferous aether supporting the propagation of electromagnetic waves, as Einstein writes in the extract from his famous paper that I reproduced in Chapter 1. The wave goes by itself. The changing electric field generates a magnetic field; the changing magnetic field generates an electric field. They hold each other up -- by their bootstraps.

Many physicists were deeply troubled by the demise of the luminiferous aether. This was one of those many cases in science when a beautiful -- or, at least, comforting -- theory is slain, in T. H. Huxley's metaphor, by an ugly fact. They had needed some mechanical model to make the whole notion of the propagation

of light in a vacuum reasonable, plausible, understandable. But this is a crutch, a symptom of our difficulties in reconnoitering realms where common sense no longer serves. The American physicist Richard Feynman described it this way:

Today, we understand better that what counts are the equations themselves and not the model used to get them. We may only question whether the equations are true or false. This is answered by doing experiments, and untold numbers of experiments have confirmed Maxwell's equations. If we take away the scaffolding he used to build it, we find that Maxwell's beautiful edifice stands on its own.

But what are these time-varying electric and magnetic fields permeating all of space? What do \vec{E} and \vec{B} mean? We feel so much more comfortable with the idea of things touching and jiggling, pushing and pulling, rather than "fields" magically moving objects at a distance, or mere mathematical abstractions. But, ^{as} Feynman ^{ed} points out, our sense that at least in everyday life we can rely on solid, sensible physical contact -- to explain, say, why the butter knife comes to you when you pick it up -- is ~~based~~ ~~on~~ a misconception. What does it mean to have physical contact? What exactly is happening when you pick up a knife, or push a swing, or make a wave in a waterbed by pressing down on it periodically? When we investigate deeply, we find that there is no physical contact. Instead, the electrical charges on your hand are influencing, when they're a very small distance away, the electrical charges on the knife or swing or waterbed. Despite everyday experience and common sense, even here, there is only the interaction of electric fields. Nothing is touching

anything.

No physicist started out impatient with common sense notions, ~~and~~ eager to replace them with some mathematical abstraction that could be understood only by rarified theoretical physics. Instead, they began, as we all do, with comfortable, standard common sense notions. The trouble is that Nature does not comply. If we no longer insist on our notions of how Nature ought to behave, but instead stand before Nature with an open and receptive mind, we find that common sense often doesn't work. Why not? Because our notions, both hereditary and learned, of how Nature works were forged in the millions of years our ancestors were hunters and gatherers. In this case common sense is a faithless guide because no hunter-gatherer's life ever depended on understanding time-variable electric and magnetic fields. There were no evolutionary penalties for ignorance of Maxwell's equations. In our time it's different.

Maxwell's equations show that a rapidly varying electric field (making \dot{E} big) ought to generate electromagnetic waves. In 1888 the German physicist Heinrich Hertz did the experiment and found that he had generated a new kind of radiation, radio waves. Seven years later, British scientists in Cambridge transmitted radio signals over a distance of a kilometer. By 1901, Guglielmo Marconi of Italy was using radio waves to communicate across the Atlantic Ocean.

The linking-up of the modern world economically, culturally, and politically by ~~undersea cables~~, microwave relays, and communication satellites traces directly back to Maxwell's esthetic judgment to include the displacement current in his vacuum equations. So does television, which imperfectly instructs and entertains us; radar, which may have been the decisive element in the Battle of Britain and therefore in the Nazi defeat in World War II (which I like to think of as "Dafty," the boy who didn't fit in, reaching into the future and saving the descendants of his tormenters); the control and navigation of airplanes, ships, and spacecraft; radio astronomy and the search for extraterrestrial intelligence; and significant aspects of the electrical power and microelectronics industries.

What's more, Maxwell's notion of fields has been enormously influential in the understanding of the atomic nucleus, quantum mechanics, and the fine structure of matter. His unification of electricity, magnetism, and light into one coherent mathematical whole is the inspiration for subsequent attempts -- some successful, some still in their rudimentary stages -- to unify all aspects of the physical world, including gravity and nuclear forces, into one grand theory. Maxwell may fairly be said to have ushered in the age of modern physics.

Our current view of the silent world of Maxwell's varying electric and magnetic vectors is described by Richard Feynman in these words:

Try to imagine what the electric and magnetic fields

look like at present in the space of this lecture room. First of all, there is a steady magnetic field; it comes from the currents in the interior of the earth -- that is, the earth's steady magnetic field. Then there are some irregular, nearly static electric fields produced perhaps by electric charges generated by friction as various people move about in their chairs and rub their coat sleeves against the chair arms. Then there are other magnetic fields produced by oscillating currents in the electrical wiring -- fields which vary at a frequency of 60 cycles per second, in synchronism with the generator at Boulder Dam. But more interesting are the electric and magnetic fields varying at much higher frequencies. For instance, as light travels from window to floor and wall to wall, there are little wiggles of the electric and magnetic fields moving along at 186,000 miles per second. Then there are also infrared waves travelling from the warm foreheads to the cold blackboard. And we have forgotten the ultraviolet light, the x-rays, and the radiowaves travelling through the room.

Flying across the room are electromagnetic waves which carry music of a jazz band. There are waves modulated by a series of impulses representing pictures of events going on in other parts of the world, or of imaginary aspirins dissolving in imaginary stomachs. To demonstrate the reality of these waves it is only necessary to turn on electronic equipment that converts these waves into pictures and sounds.

If we go into further detail to analyze even the smallest wiggles, there are tiny electromagnetic waves that have come into the room from enormous distances. There are now tiny oscillations of the electric field, whose crests are separated by a distance of one foot, that have come from millions of miles away, transmitted to the earth from the Mariner [2] space craft which has just passed Venus. Its signals carry summaries of information it has picked up about the planets (information obtained from electromagnetic waves that travelled from the planet to the space craft).

There are very tiny wiggles of the electric and magnetic fields that are waves which originated billions of light years away -- from galaxies in the remotest corners of the universe. That this is true has been found by 'filling the room with wires' -- by building antennas as large as this room. Such radiowaves have been detected from places in space beyond the range of the greatest optical telescopes. Even they, the optical telescopes, are simply gatherers of electromagnetic waves. What we call the stars are only inferences, inferences drawn from the only physical reality we have yet gotten from them -- from a careful study of the unendingly complex undulations of the electric and magnetic fields reaching us on earth.

There is, of course, more: the fields produced by lightning miles away, the fields of the charged cosmic ray particles as they zip through the room, and more, and more. What a complicated thing is the electric field in the space around you!

If Queen Victoria had ever called an urgent meeting of her ~~most important~~ counselors, and ordered them to invent the equivalent of radio and television, it is unlikely that any of them would have imagined the path to lead through the experiments of Oersted and Faraday, four equations of vector calculus, and the esthetic judgment to preserve the displacement current in a vacuum. They would, I think, have gotten nowhere. Meanwhile, on his own, driven only by curiosity, costing the government almost nothing, himself unaware that he was laying the ground for the Westminster Project, "Dafty" was scribbling away. It's ~~doubtful~~ ^{entirely} ~~whether~~ ^{that} the self-effacing, unsocial Mr. Maxwell would even have been thought of to perform such a study. If he had, ~~doubtless~~ ^{probably} the government would have been telling him what to think about and what not, impeding rather than inducing his great discovery.

Late in life, Maxwell did have one interview with Queen Victoria. He worried about it beforehand -- essentially about his ability to communicate science to a non-expert -- but the Queen was distracted and the interview was short. Like the three other greatest British scientists of recent history, Michael Faraday, Charles Darwin, and Francis Crick, Maxwell was never knighted (although Lyell, Kelvin, J. J. Thomson, Rutherford, Eddington, and Hoyle in the next tier were). In Maxwell's case,

there was not even the excuse that he might hold opinions at variance with the Church of England: He was an absolutely conventional Christian for his time, more devout than most. Maybe it was his nerdishness.

The communications media -- the instruments of education and entertainment that James Clerk Maxwell made possible -- have never, so far as I know, offered even a mini-series on the life and thoughts of their benefactor and founder [check BBC]. By contrast, think of how difficult it is to grow up in America without television teaching you about, say, the life and times of Davy Crockett or Billy the Kid or Al Capone.

Maxwell married young, but the bond seems to have been passionless as well as childless. His excitement was reserved for science. This founder of the modern age died in 1879 at the age of 47. While he is almost forgotten in popular culture, radar astronomers who map other worlds have remembered: A great mountain range on Venus is named for him.

* * *

Less than a ^{century} ~~hundred years~~ after Maxwell's prediction of radio waves, the first search was initiated for signals from possible civilizations on planets of other stars. Since then there have been a number of studies, some of which I referred to earlier, for the time-varying electric and magnetic fields

crossing the vast interstellar distances from ^{conceivable} other intelligent ^{beings} -- biologically very different from us -- who had also benefited sometime in their histories by the insights of alien counterparts of James Clerk Maxwell.

In October 1992, in the Mojave Desert, and in a Puerto Rican karst valley, we initiated by far the most promising, powerful, and comprehensive search for extraterrestrial intelligence (SETI). For the first time NASA would organize and operate the program. The entire sky would be searched over a 10-year period with unprecedented sensitivity and frequency range. If, on a planet of any of the 400 billion other stars that make up the Milky Way Galaxy, anyone had been sending us a radio message, we might have had a pretty fair chance of hearing them.

Just one year later, Congress pulled the plug. SETI was not of pressing importance; its interest was limited; it was too expensive. But every civilization in human history has devoted some of its resources to investigating deep questions about the Universe, and it's hard to think of a deeper one than whether we are alone. Even if we never decrypted the message contents, the receipt of such a signal would transform our view of our universe and ourselves. And if we could understand the message from an advanced technical civilization, the practical benefits might be unprecedented. Far from being narrowly based, the SETI program, strongly supported by the scientific community, is also embedded in popular culture. The fascination with this enterprise is

[12-11-94.at1]

Quint O, Ch 21, p. 24

For ~~The Demon-Haunted World~~:

David Goodstein, a physicist at Cal Tech, notes that science has been growing nearly exponentially for centuries and that it cannot continue such growth -- because then everybody on the planet would have to be a scientist, and ~~even~~ then the growth would have to stop. He proposes that for this ~~very fundamental~~ reason, and not because of any fundamental disaffection from science, the funding of science has slowed measurably in the last few decades. *PP Nevertheless, I'm worried about how research funds are distributed - (N.PP)*

broad and enduring, and for very good reason. And far from being too expensive, the program would have cost about an attack helicopter per year.

I wonder why those members of Congress concerned about cost don't devote greater attention to the Department of Defense -- which, with the Soviet Union gone and the Cold War over, still spends, when all costs are tallied, well over \$300 billion a year. (And elsewhere in government, there are many programs that amount to welfare for the well-to-do.) Perhaps our descendants will look back on our time and marvel at us -- possessed of the technology to detect other beings, but closing our ears because we insisted on spending the national wealth to protect us from an enemy that no longer exists.

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I'm worried that cancelling SETI is part of a trend. The Government has been pressuring the National Science Foundation to move away from basic scientific research and to support technology, engineering, applications. NASA support for research and analysis of data already obtained is increasingly constrained. Many young scientists are not only unable to find grants to support their research; they are unable to find jobs. Corporations are steadily decreasing their research budgets. In the last quarter century, the proportion of the federal budget devoted to research has plummeted from 5.2 percent to 1.8 percent.

Congress is suggesting doing away with the U.S. Geological Survey.

Industrial research and development funded by American companies has slowed across the board in recent years. Government funding for research and development has declined in the same period. (Only military research and development increased in the decade of the 1980s.) In fields such as computers, telecommunications equipment, aerospace, machine tools and robotics, and scientific precision equipment, the U.S. share of global exports has been declining, while the Japanese share has been increasing. In that same period the United States lost its lead to Japan in most semiconductor technologies. It experienced severe declines in market share of color TVs, VCRs, phonographs, telephone sets, and machine tools. The U.S., after all, was busy winning the Cold War.

Basic research is where scientists are free to pursue their curiosity and interrogate Nature, not with any short-term practical end in view, but to seek knowledge for its own sake. Scientists of course have a vested interest in basic research. It's what they like to do, in many cases why they became scientists in the first place. But it is in society's interest to support such research. This is how the major discoveries that benefit humanity are made. Whether a few grand and ambitious scientific projects are a better investment than a larger number of small programs is a worthy question. But overall we need more, not fewer, research expenditures.

We are rarely smart enough to set about on purpose making the discoveries that will drive our economy and safeguard our lives. Often, we lack the fundamental research. Instead, we pursue a broad range of investigations of Nature, and applications we never dreamed of emerge. Not always, of course. But often enough.

Giving money to someone like Maxwell might have seemed the most absurd encouragement of mere "curiosity-driven" science, and an imprudent judgment by practical legislators. Why grant money now, so nerdish scientists talking incomprehensible gibberish can indulge their hobbies, when there are urgent unmet national needs? From this point of view it's easy to understand the contention that science is just another lobby, another pressure group anxious to keep the grant money rolling in so the scientists don't ever have to do a hard day's work or meet a payroll.

Maxwell wasn't thinking of radio, radar, and television when he first scratched out the fundamental equations of electromagnetism; Newton wasn't dreaming of space flight or communications satellites when he first understood the motion of the Moon; Roentgen wasn't contemplating medical diagnosis when he investigated a penetrating radiation so mysterious that it was called "X-rays"; Curie wasn't thinking of cancer therapy when she painstakingly extracted minute amounts of radium from tons of pitchblende; Fleming wasn't planning on saving the lives of

millions with antibiotics when he noticed a circle free of bacteria around a growth of mold; Watson and Crick weren't imagining the cure of genetic diseases when they puzzled over the x-ray diffractometry of DNA; Rowland and Molina weren't planning to implicate CFCs in ozone depletion when they began studying stratospheric photochemistry.

These discoveries and a multitude of others that grace and characterize our time, to some of which our very lives are beholden, were made ultimately by scientists given the opportunity to explore what in their opinion, under the scrutiny of their peers, were basic questions in Nature. Industrial applications, in which Japan in the last two decades has done so well, are excellent. But applications of what? Fundamental research, research into the heart of Nature, is the means by which we acquire the new knowledge that gets applied.

Scientists have an obligation, especially when asking for big money, to explain with great clarity and honesty what they're after. The Superconducting Supercollider (SSC) would have been the preeminent instrument on the planet for probing the fine structure of matter and the nature of the early Universe; its price tag was \$10 to \$15 billion; it was cancelled by Congress in 1993 ~~{check}~~ after about \$2 billion had been spent -- a worst of both worlds outcome. But this debate is not, I think, mainly about declining interest in the support of science. Few in Congress understood what modern high energy accelerators are for.

They are not for weapons. They have no practical applications. They are for something that is from the point of view of many worrisomely called "the theory of everything." Explanations that involve entities called quarks, charm, flavor, color, etc. sound as if physicists are being cute. The whole thing has an aura, in the view of at least some Congresspeople I've talked to, of "nerds gone wild" -- which I suppose is an uncharitable way of describing curiosity-based science. No one asked to pay for this had the foggiest idea of what a Higgs boson is. I've read some of the material intended to justify the SSC. At the very end, some of it wasn't too bad, but there was nothing that really addressed what the project was about on a level accessible to bright but skeptical non-physicists. If physicists are asking for 10 or 20 billion dollars to build a machine that has no practical value, at the very least they should make an extremely serious effort, with dazzling graphics, metaphors, and capable use of the English language, to justify their proposal. More than financial mismanagement, budgetary constraints, and political incompetence, I think this is the key to the failure of the SSC.

There is a free-market view of human knowledge, according to which basic research should compete for scarce resources and without government support with all the other institutions and claimants in the society. Here, for example, is an excerpt from a letter written in response to a syndicated article of mine that

made some of the above points:

Hurrah for Congress! It's pulling the plug on funding scientists engaged in "basic research." Hopefully, in two or three years Congress will appropriate zero dollars of our tax money for "basic research."

Sagan cites several people whom he considers to have made significant contributions, people who as a matter of record made their contributions without a nickel of tax money: Maxwell, Newton, Roentgen, Curie.

Sagan is just looking for a handout for a group of people who can't compete successfully for dollars in a free market economy. Let's treat him as just another "special interest" pleader to whom Congress should turn a deaf ear.

In fact, all four of these great scientists received government support for their research, if we include scholarships, fellowships, and grants from the nobility who were running the country. This complaint is reminiscent of John Chancellor's remarks on access of science to television, described in the previous chapter. It's a view that's always been with us, and arguably one that's been increasingly articulated lately. If they couldn't have relied on government support, and had to compete in the free market economy of their day, it's unlikely that any of the scientists on my list would have been able to do their groundbreaking research. And the cost of basic research is substantially greater than it was in Maxwell's day -- both theoretical and, especially, experimental.

But that aside, would free market forces be adequate to support basic research? A fundamental aspect of basic research is that its applications lie in the future -- sometimes decades or even centuries ahead. What's more, no one knows which aspects of basic research will have practical value and which will not.

If scientists cannot make such predictions, is it likely that politicians or industrialists can? If free market forces are focused only towards short-term profit -- as they certainly are in an America with steep declines in corporate research -- is not this solution tantamount to abandoning basic research?

Cutting off fundamental, curiosity-driven science is like eating the seed corn. We may have slightly more to eat next winter, but what will we plant so we and our children will have enough in the winters to come?

Of course there are many pressing problems facing our nation and our species. But reducing basic scientific research is not the way to solve them. Scientists do not constitute a voting block. They have no effective lobby. However, much of their work is in everybody's interest. Backing off from fundamental research constitutes a failure of nerve, of imagination, and of that vision thing that we still don't seem to have a handle on. It might strike one of those hypothetical extraterrestrials that we were planning not to have a future.

Of course we need literacy, education, jobs, adequate medical care and defense, protection of the environment, security in our old age, and a host of other matters. But we are a rich society. Can't we also nurture the Maxwells of our time? To take one symbolic example, is it really true that we can't afford one attack helicopter's worth of seed corn?

[M, 11/28/94]

Chapter 22

REAL PATRIOTS ASK QUESTIONS*

*are to calculate an eclipse.
-- Mark Twain, 1903.*

Ubi dubium ibi libertas: Where there is doubt, there is freedom.

-- Latin proverb

The truth is, almost all the men and women of our nation or any other get their religion and their politics where they get their astronomy -- entirely at second hand. Being untrained, they are no more able to intelligently examine a dogma or a policy than they

Once, in the closing years of the Soviet Union, Ann Druyan

and I found ourselves at a dinner in Peredelkino, a village outside Moscow where Communist Party officials, retired generals, and a few favored intellectuals have their summer homes. The air was electric with the prospect of new freedoms -- especially the right to speak your mind even if the government doesn't like what you're saying. The fabled revolution of rising expectations was in full flower.

But, despite glasnost, there were widespread doubts. Would those in power really allow their own critics to be heard? Would freedom of speech, of assembly, of the press, of religion, really be permitted? Would people inexperienced with freedom be able to bear its burdens?

Some of the Soviet citizens present at the dinner had fought -- for decades and against long odds -- for the freedoms that most Americans take for granted; indeed, they had been inspired by the American experiment, a real-world demonstration that nations, even multicultural and multiethnic nations, could

*Written with Ann Druyan.

survive and prosper with these freedoms reasonably intact. They went so far as to raise the possibility that prosperity was due to freedom -- that, in an age of high technology and swift change, the two rise or fall together.

There were many toasts, as there always are at dinners in that part of the world. The most memorable was given by a world-famous Soviet novelist. He stood up, raised his glass, looked us in the eye, and said, "To the Americans. They have a little freedom." He paused, and then added: "And they know how to keep it."

Do we?

* * *

The ink was barely dry on the Bill of Rights before politicians found a way to subvert it -- by cashing in on fear and patriotic hysteria. In 1798, the ruling Federalist Party knew that the button to push was prejudice. Exploiting tensions between France and the U.S., and a widespread fear that French and Irish immigrants were somehow intrinsically unfit to be Americans, the Federalists passed a set of laws that have come to be known as the Alien and Sedition Acts.

One law upped the residency requirement for citizenship from five to 14 years. (Citizens of French and Irish origin usually voted for the opposition, Thomas Jefferson's Democratic-

Republican Party.) The Alien Act gave President John Adams the power to deport any foreigner who aroused his suspicions. Making the President nervous, said a member of Congress, "is the new crime." Jefferson believed the Alien Act had been framed explicitly to expel C. F. Volney, the French historian; Pierre Samuel du Pont de Nemours, patriarch of the famous chemical family; and the British scientist Joseph Priestley, the discoverer of oxygen and an intellectual antecedent of James Clerk Maxwell. In Jefferson's view, these were just the sort of people America needed.

The Sedition Act made it unlawful to publish "false or malicious" criticism of the government or to inspire opposition to any of its acts. Some two dozen arrests were made, ten people were convicted, and many more were censored or intimidated into silence. The act attempted, Jefferson said, "to crush all political opposition by making criticism of Federalist officials or policies a crime."

As soon as Jefferson was elected, indeed in the first week of his Presidency in 1801, he began pardoning every victim of the Sedition Act because, he said, it was as contrary to the spirit of American freedoms as if Congress had ordered us all to fall down and worship a golden calf. By 1802, none of the Alien and Sedition Acts remained on the books.

From across 200 years, it's hard to recapture the frenzied mood that made the French and the "wild Irish" seem so grave a

threat that we were willing to surrender our most precious freedoms. Giving credit for French and Irish cultural triumphs, advocating equal rights for them, was in effect decried in conservative circles as sentimental -- unrealistic political correctness. But that's how it always works. It always seems an aberration later, but by then we're in the grip of the next hysteria.

Those who seek power at any price detect a societal weakness, a fear that they can ride into office. It could be ethnic differences, as it was then, or perhaps different amounts of melanin in the skin; different philosophies or religions; or maybe it's drug use, violent crime, economic crisis, school prayer, or "desecrating" (literally, making unholy) the flag.

Whatever the problem, the quick fix is to shave a little freedom off the Bill of Rights. Yes, in 1942, Japanese-Americans were protected by the Bill of Rights, but we locked them up anyway -- after all, there was a war on. Yes, there are prohibitions against unreasonable search and seizure, but we have a war on drugs. Yes, there's freedom of speech, but we don't want foreign authors here, spouting alien ideologies, do we? The pretexts change from year to year, but the result remains the same: concentrating more power in fewer hands and suppressing diversity of opinion -- even though, as science plainly shows, it's central to our future.